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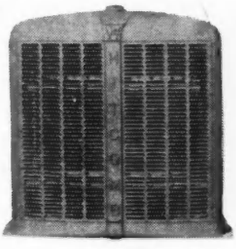

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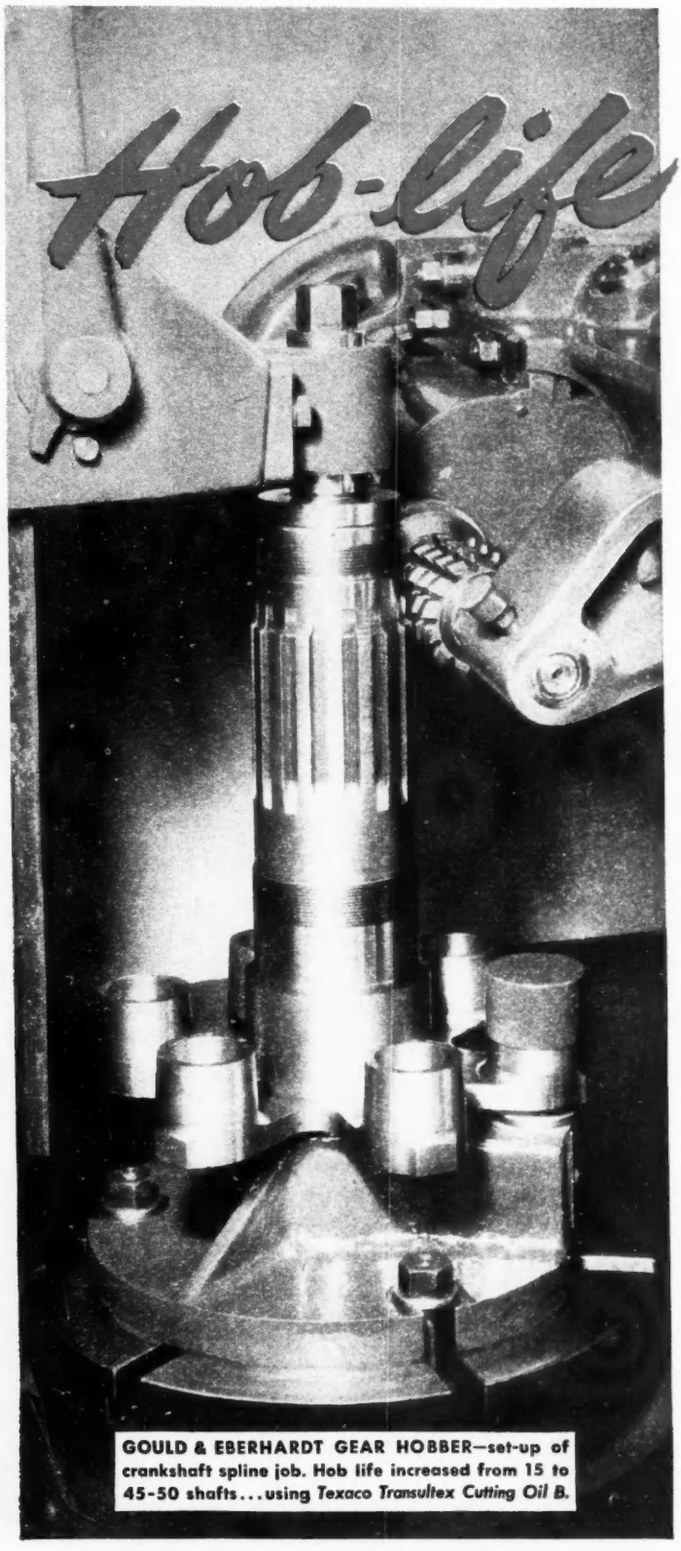

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IN THIS ISSUE . . . .

AUTOMOTIVE and AVIATION INDUSTRIES

Volume 87 November 1, 1942 Number 9

AUTOMOTIVE INDUSTRIES

Reg. U. S. Pat. Off.

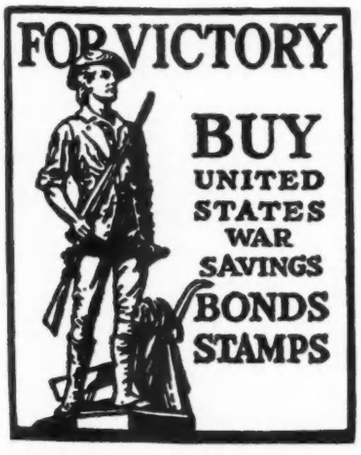
Goal of 2,000,000 Tons of Scrap

Early reports from salesmen engaged in the American Steel Warehouse Association drive for dormant scrap metal support the contention of the WPB that vast tonnage of scrap lies unused in 250,000 industrial plants of America.

This statement was made in Cleveland on Monday, October 26 by John J. Hill, Jr., national chairman of the A.S.W.A. drive. He made the report at the meeting of the board of directors of the national association in the Cleveland Hotel.

"We have set a goal of two million tons. That sounds like a lot of scrap, but it is not more than we will need when the snow and ice of January and February are interfering with the processing of scrap in the junk yard.

"Our early reports indicate the unanimous interest and enthusiasm of 354 company members of the American Steel Warehouse Association located in 97 cities coast to coast. They have assigned about 1000 full-time salesmen to ferret out the dormant scrap in industrial places."



Delco-Remy Aluminum Foundry 18

In this plant there are 205 different kinds of casting being made. With the importance of aluminum production this should prove to be one of the "must read" articles in this issue.

Curtiss Commando 24

This giant military cargo plane has been the center of much interest. Here is a description and some pictures that should place you in the ranks of the well informed.

Removal of Broken Tools from Drilled Holes 30

In this article will be found the answer to one of the most troublesome problems in plant operation. It is a wholly new technique. It not only saves time but saves many parts from going to salvage.

Exhaust Manifolds for Radial Aircraft Engines 26

The methods of producing Ryan manifolds is told in this article by the factory superintendent. No better source of information could be conceived for the description of methods that have made the Ryan Aeronautical Co. outstanding. Well illustrated too.

Ternstedt Now Making Aircraft Instruments 32

Taking on a complete new job and how it was all accomplished is the story told. Ternstedt never made anything that compared with the fine instruments or required the close tolerances that their present output calls for. It was an entirely new setup.

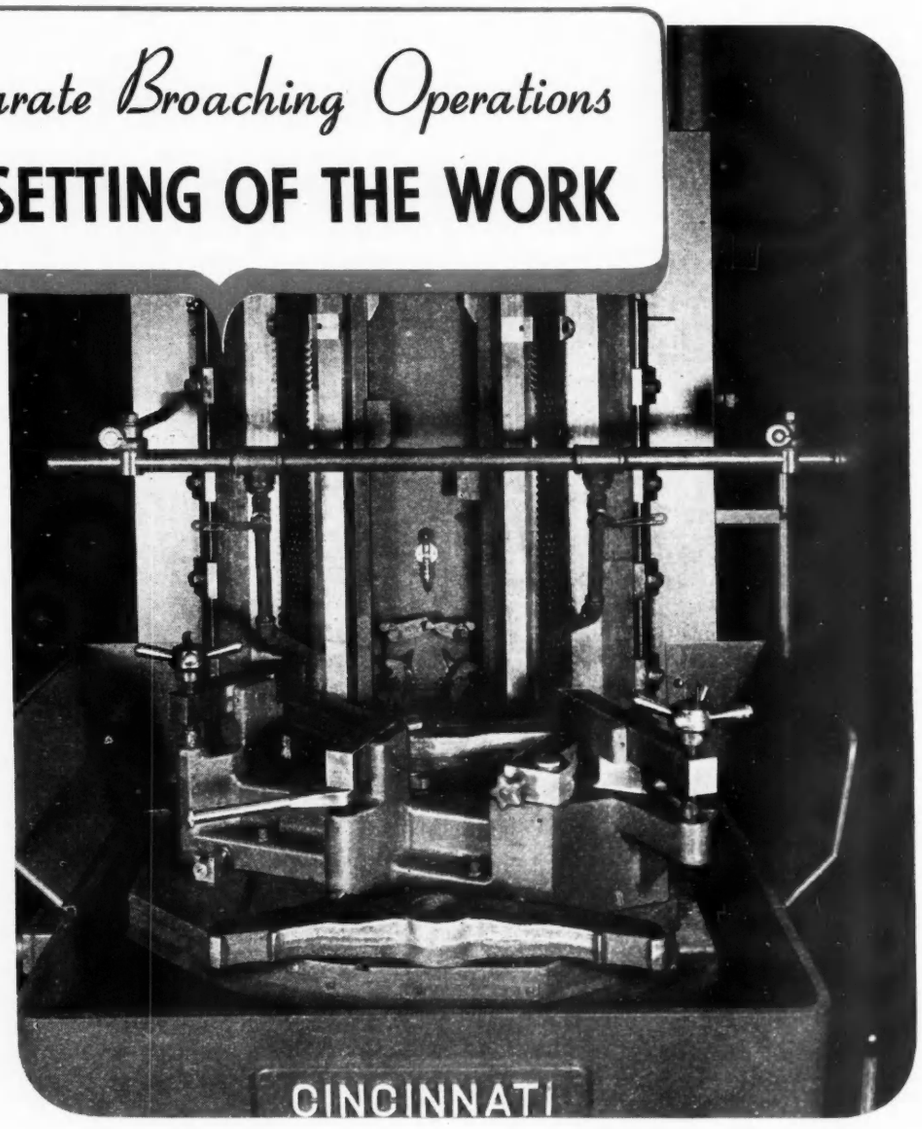
The Unionmelt Welding Process 36

In this day of all out for war production, methods of fabrication and assembling call for new and faster methods. Here is the description of one that you should read, if only to be well informed.

Production Equipment 42

A lot of new things have come up on the production horizon. Turn to page 42 and become acquainted with the latest.

Two Separate Broaching Operations
IN ONE SETTING OF THE WORK

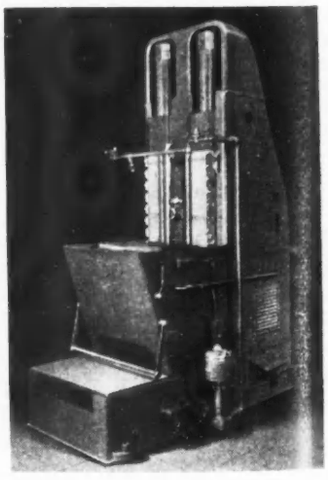


THIS illustration shows a common-sense application of broaching to the more rapid production of war materiel. Two flat surfaces, 28" apart and at an angle to each other, must be machined on tank parts to close limits of accuracy. Both operations are completed in one setting of the work . . . an ordinary procedure in the production of small and compact parts but an innovation in machining large parts by the rapid broaching process.

> *A recess approximately 1/4" deep is broached in each end of the part, a heavy steel forging. Operating cycle: clamp part in fixture; broach one end; automatically swivel table; broach other end; automatically stop; remove part. The machine—a CINCINNATI No. 10-66 Duplex Vertical Hydro-Broach.*

Much of the credit for the success of this operation goes to the exclusive CINCINNATI swivel table arrangement.

When conventional machining methods bog down production, why not consider unconventional machines for increasing your war-time production? In surface broaching, look to CINCINNATI for recommendations.



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AUTOMOTIVE and AVIATION INDUSTRIES

Published on the 1st and 15th of the month

Vol. 87, No. 9
November 1, 1942

Why Automotive Manufacturers

Prefer Balanced Flow for Materials Control

By E. L. Warner, Jr.

IN PROPOSING the Balanced Flow plan to the War Production Board for the control of materials in the manufacture of armament and munitions, leaders of the automotive industry were backed by more than 30 years' experience in mass production. As the outstanding pre-war example of volume production, the automotive industry has depended upon the successful distribution of materials on a flow basis as the key to its success. Production has been scheduled on a progressive flow basis, with a minimum of inventories on hand, and with inventory turn over 18 to 24 times in a model year.

The Balanced Flow plan as submitted to WPB was drawn up by Ernest C. Kanzler, WPB director general of operations and former chief of the Automotive Branch. He drew upon his own experience as a manufacturing executive for Ford Motor Co., more than 20 years' close association with the automotive industry and his service as head of the Automotive Branch.

Balanced, planned and controlled flow of materials is one of the vital requirements of mass production as practiced by the automotive industry. The industry developed the lean "float" of materials during the model changeover period. Material flow had to be closely controlled to production requirements at the end of the model run, if the manufacturer was not going to take an economic beating. Balancing material needs at this point was necessary in starting output on a new model and the technique of material control was developed to a high degree. The chief difference in war production is that the model change is dictated by strategic considerations and improvement in the enemy's weapons rather than by the calendar.

The Steel Budget plan, previously prepared by the Iron and Steel Branch of WPB, calls for allocation of materials on a stockpile basis, with stockpiles replenished when needed. Each manufacturer goes to WPB to obtain a specific allotment of steel or other raw material, for which he receives a certification upon which he can draw the steel or material which he has been allocated. He must prove his needs before having his steel orders approved.

The Balanced Flow plan is a production scheduling system based on the fundamental of balancing available material supply against the material requirements of production schedules. Monthly production is scheduled in relation to the raw materials available, thus keeping work-in-process to a minimum. In this way it minimizes the possibility that guns or tanks may be left in a partially finished state due to lack of some part or sub-assembly for which materials are not available.

A prerequisite of the Balanced Flow plan is that the government obtain accurate bills of material for each finished war product showing the amount of each material that goes into that particular product. Then the government must determine the amount of materials that will be available over a period of several months. Issuance of production schedules for which materials are not available results in confusion in manufacturing and unbalanced inventories.

The government services and agencies must determine what finished war products are needed and what can be produced with the materials available. Each war contractor must be notified the number of finished products to be produced in a specific month. Production schedules must be drawn up early enough to permit the obtaining of materials as needed for production. It is the job of the prime contractor to notify his subcontractors and suppliers of the month's production schedule. Then the prime and subcontractors place material orders for the number of war products required in the schedule. Orders in excess of needs would be regarded as violations of the material control system and would be dealt with by the government. Subcontractors report the amount of material ordered to the prime contractor and he reports to the government. Thus the WPB has a pre-audit of material requirements before delivery and this can be checked

(*Turn to page* 41, *please*)

It is believed, as this issue goes to press, that WPB's new Material Distribution Plan, reportedly to be announced Nov. 2, will prove to be a compromise between the Steel Budget Plan and the Balanced Flow Plan. Presented here are the arguments advanced in favor of the latter plan which has been used by automotive manufacturers with remarkable effectiveness for more than 30 years.—Ed.

As an example of mechanization consider this heavy duty monorail conveyor designed for the transportation of cores into and out of the ovens.

Delco-Remy

CONSIDERING the vital role of aluminum in the war program, it is of great interest to find that Delco-Remy Division, General Motors Corp., is operating an aluminum foundry supplying parts for airplane engines. Altogether, Delco-Remy is producing 205 different kinds of castings ranging from the large crankcase to pieces weighing less than a pound. Judged by experts to be one of the most highly mechanized foundries in the industry, mechanization has been tempered with judgment so as to achieve a maximum degree of flexibility. Consequently, the mass-production setup is geared for the economical routing of over 205 different parts and accommodating seven different aluminum alloy specifications.

(Right) Perspective of main merry-go-round molding conveyor, showing the drugs made up directly on the conveyor, the copes being fitted with the aid of traveling cranes.

(Below) One of the post-type Shaw-Box boom crane units used in the assembly of cores for the drag.

(Right) Here is a perspective of the battery of nose-tilting, gas-fired furnaces in the melting department. Note the craneways and hoists for handling the heavy loads, exhaust hoods and ventilating fans—all designed to provide the maximum of worker comfort.

Aluminum Foundry

By Joseph Geschelin

This is the Seventy-fifth in the series of monthly production features

The casting of aluminum parts that "fly" is an exacting procedure predicated upon a background of scientific research and close metallurgical control. This is not obvious to the casual observer save for the physical evidence of an excellent metallurgical laboratory, fitted with X-ray equipment, a large spectrograph, and other essential facilities. Nevertheless, the very conception of the design and layout and operation of the foundry rests upon the following factors, considered to be of controlling importance in airplane quality aluminum castings:

1. Control of surface finish
2. Control of internal imperfections
3. Precise control of physical properties
4. Close control of dimensional tolerances

How each of these exerts its influence upon foundry practice in this plant may be briefly sketched as follows:

1. Control of surface finish implies that practically all pinholes, grinding marks, sand cracks, fins, etc., must be removed. From one standpoint this means adequate cleaning room facilities; from another, it imposes on the molding department and sand control set-up the responsibility for eliminating such imperfections in the course of foundry operations so as to reduce the burden on the finishing room.

2. Control of internal imperfections embraces the elimination of shrinks, blow-holes, dross, and cracks. This is achieved by constant watch over every step of the foundry procedure and by vigilant work on the part of the research department.

3. Precise control of physical properties involves the following factors:

a. Exacting control of chemistry of the alloys
b. Close control of pouring temperature
c. Improved gating and pouring procedures
d. Constant checking of test bars
e. Modern heat treating equipment and precise control

4. Control of dimensional tolerances is concommitant with the lightness demanded of castings that "fly." All major castings are produced in well designed metal fixtures, locating pads are filed and each one closely

inspected. Many of the castings are water-tested.

Considering the scope of these technical requirements, it is amazing to find that the foundrymen in this plant are men who, generally speaking, had no previous training or experience in aluminum foundry operation, but were recruited from the payroll of the Delco-Remy machine shop departments.

From the physical standpoint, this foundry typifies modernity. It is new and clean, with provisions for excellent daylight and artificial lighting. A comprehensive ventilating and exhaust system, served by a suitable dust collector installation makes for a clean and dust-free place in which to work. The plant has its own facilities for making patterns and tools, providing complete control of these important functions.

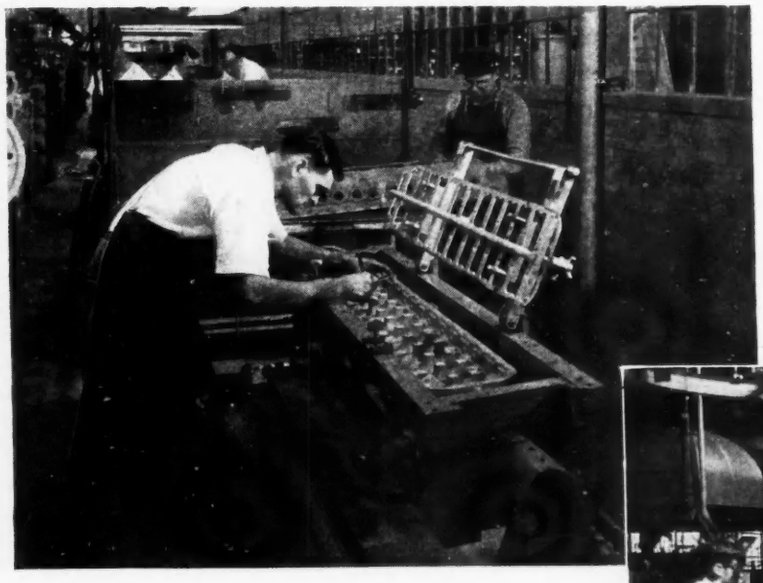
The scope of the technical facilities of the foundry may be better visualized by touching on some of the exceptional highlights. Here, for example, is the process of the elimination of waste, drawing upon the most economical utilization of critical materials. All of the gates, risers, flash, scrap, etc., are suitably prepared and immediately re-used by re-melting in a battery of open-hearth furnaces. Important feature of this equipment is the installation of a continuous conveyor serving each furnace. The conveyor carries molds into which the metal is poured in the form of pigs. At the shake-out grates, they have developed a system of downdraft ventilation in which the air stream is forced downward, carrying dirt and dust into the pit below, thus maintaining an unusually clean working atmosphere.

The presence of iron wire in the aluminum castings is usually a troublesome problem. Here the castings are immersed in an acid bath which dissolves all of the iron without affecting the aluminum in any way. The condition of the nitric acid bath is checked constantly by the laboratory, dumped when the acid approaches lack of effectiveness.

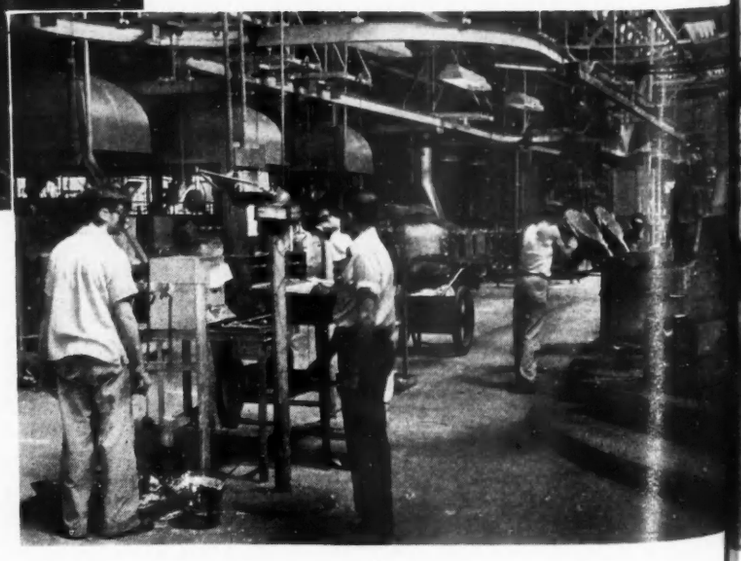
Materials handling plays a major role in the foundry operation. Major molding and pouring operations are done on a merry-go-round floor conveyor. The core department is traversed by a monorail conveyor carrying trays to accommodate the finished cores which are moved to the baking ovens. A Matthews system of gravity roller conveyors is employed for moving flask sections from the shake-out to the molding stations. Cranes traverse the molding lines for transporting the heavy flask sections. Core assemblies and small molds are handled by means of post-type boom cranes fitted with Shaw-Box hoists.

In addition to the sand foundry operation, there is a permanent mold department in which many small castings are made. While the tonnage is relatively small at present, this department is considered to be a valuable adjunct to the foundry and is currently in the process of expansion. Another outstanding development now under way, experimentally, is the adoption of a unique method for producing large castings with plaster molds instead of sand molding. This project has been under way for a considerable length of time and is about ready to translate to practice.

Coming to the details of foundry departments, let us consider, first, the melting department. This contains a large number of nose-tilting, gas-fired furnaces with refractory crucibles to prevent contamination of the virgin aluminum alloy. Each furnace produces about 300 lb of metal per hour at pouring temperature.



(Above) One of the massive steel fixtures employed in the checking of finished castings before they are approved for shipment.



(Right) This is the pouring station on the main merry-go-round molding conveyor line, with the exhaust hoods directly in the background. At the left foreground, is the prime control of the entire set-up—testing and adjustment of pouring ladle temperature.

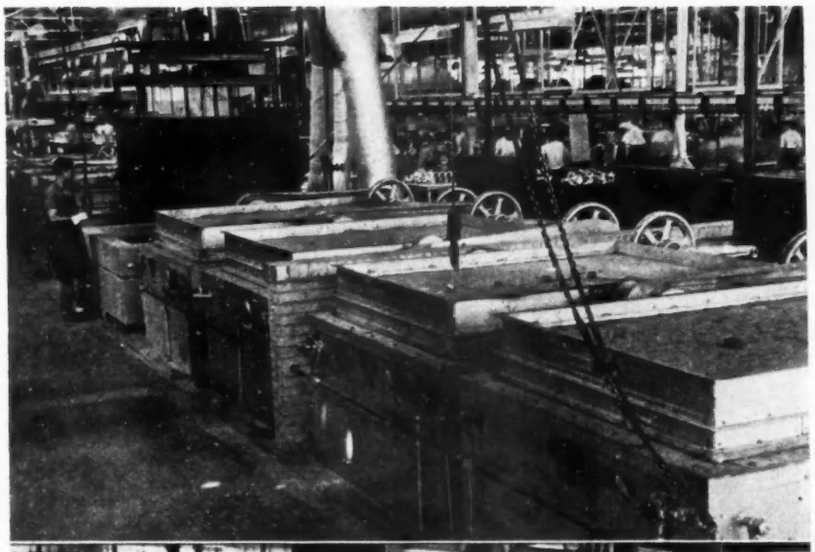
The molten metal is transferred from the furnace to the pouring ladle which is suspended from a monorail. The operator then pushes the ladle into pouring position where the height of the ladle is controlled electrically by another operator.

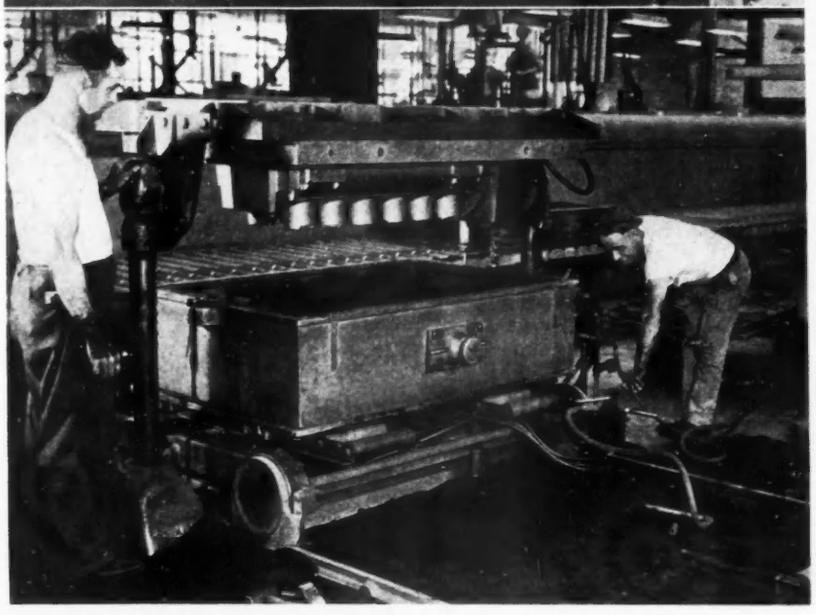
A number of direct, gas-fired, open-hearth furnaces are used for refining and controlling the scrap metal. Each one is capable of melting approximately two tons per hour. To insure close control of the chemistry of the pigs produced by this furnace, a sample from every batch of 5000 lb of metal is analyzed by the laboratory.

Melting temperatures are kept below 1500 F to avoid gas absorption and general oxidation, pouring temperatures being kept as low as is consistent with the necessary fluidity for a given casting. Holding molten metal for long periods at elevated temperatures is avoided since the gas absorption and general oxidation tend to lower its physical properties.

The only powder fluxing used is in the direct fired open-hearth furnace where a chloride-fluoride flux is used in refining the gates, risers, sprues and scrap castings. Chlorine gas is occasionally used in the pot furnaces as a flux.

In molding, one of three types of



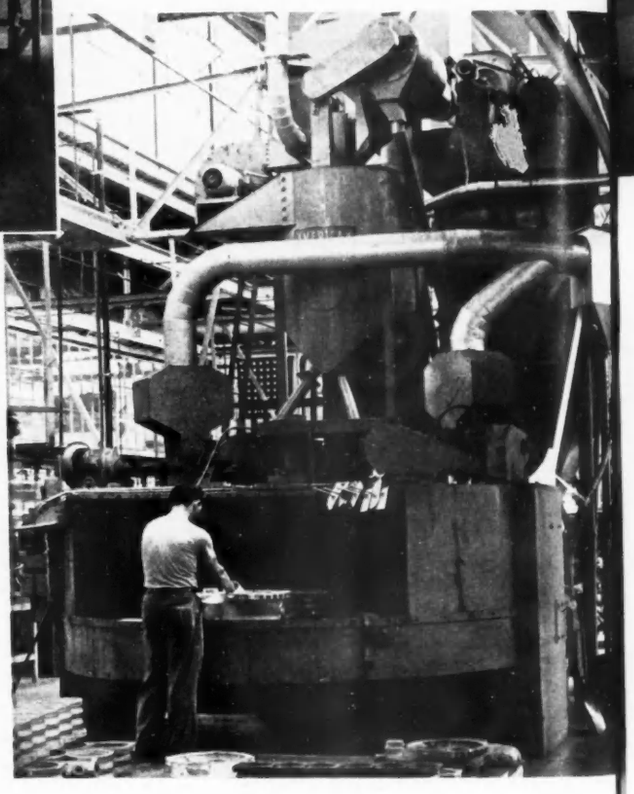


(Top) In foreground is part of a battery of Lindberg pit type electric furnaces utilized for the solution treatment of aluminum castings.

(Above) Copes are prepared on these big Osborn jolt squeeze, roll-over molding machines developed for this installation.

(Left) A shake-out station showing means for dumping molding sand through the grate to conveyor belting below. At the left the cleaned flask sections are lifted onto the Matthews roller conveyor for transportation to the molding stations.

(Below) This American Wheelabrator is one of the special machines installed in the cleaning department where castings are prepared by sand-blasting, or grit-blasting depending upon the nature of the finish specified by the customer.



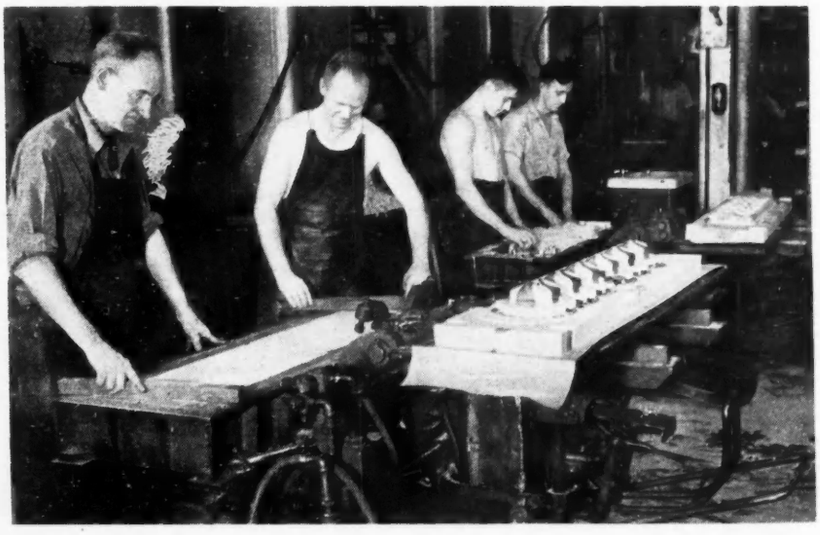
(Above) One of the benches in the polishing department where all castings are filed, burred, etc., with special Aro portable tools.

machines—squeezer, jolt roll-over, or jolt squeeze roll-over—is employed depending upon the size of the mold. Jolt roll-over molding machines used both in the molding and core departments are made by International; the special jolt squeeze roll-over machines for the copes are made by Osborn.

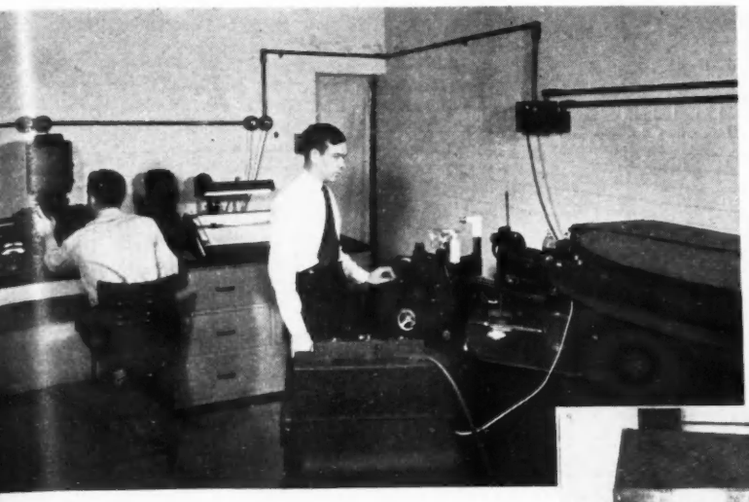
The jolt roll-over and the jolt squeeze roll-over types are arranged in a straight line so that the copes can be placed on the drags as the drags pass the cope machines on the conveyor. The squeezer machines are arranged for molding in the conventional floor style without conveyor. Molds are poured on the conveyor as they pass the melting station.

Molding and pouring are done on large merry-go-round conveyors of several types made by Link-Belt. These constitute excellent examples of mass-production techniques, involve the scheduling of cores to the proper stations along the line, installation of core assemblies being done with the aid of Budgit hoists or the post type ½-ton Shaw-Box boom cranes. Drags are made up directly on the conveyor while the copes are built up in the Osborn machines on an outer line.

Important as a measure of quality control is that instead of conventional sprue practice, they make up individual slotted dry sand down sprues containing a number of narrow slots. This provides a positive metering and timing of flow, also serves to skim the dross. As a part of the control of the metal condition, each ladle is checked for temperature with a thermocouple type pyrometer before pouring. Following conventional practice, the molds



In the core room—International jolt. roll-over molding machines are used in making the intricate dry sand cores.



(Left) The spectrographic laboratory.

(Below) A view in Delco-Remy's X-ray department, showing a typical group of airplane engine castings on which X-ray studies are made.

move through a hooded exhaust section built over the conveyor to remove dust and fumes before the molds reach the shake-out. At the shake-out, the flask sections are cleaned, placed on a Matthews gravity roller conveyor which returns them to the molding stations.

As a vital element in quality control as well as in the reduction of work in the cleaning rooms, control of the molding sand is given special attention. The laboratory after considerable work has adopted a special type of semi-synthetic sand to provide improved characteristics.

One of the major activities of the foundry is found in the cleaning rooms where surface quality is maintained by various means. Here is a closed monorail conveyor line for the preparatory chipping, grinding, and snagging operations. Final touches of filing and polishing are made on benches, provided with Aro portable tools of various kinds. Castings are cleaned by sand-blasting, shot-blasting, or grit-blasting, depending upon the nature of the surface finish specified by the customer. Suitable equipment for this purpose, supplied by Sly and American Wheelabrator is found in the cleaning department. Quality control in the cleaning department is handled by inspectors who work on special benches fitted with fluorescent light sources to provide improved seeing conditions for this exacting task.

All castings are given a special heat treatment depending upon the size of the casting and the requirements in each instance. Large castings are heat treated to increase hardness, to increase tensile properties, and to improve machinability. Some castings are simply given an aging treatment to increase surface hardness. The large major castings going into the engine structure are permanently identified as to heat treatment and a special serial number.

The heat treating department consists of twenty-six Lindberg electric and gas pit type furnaces for solution treatment and aging. All are of rectangular shape and have air operated tops which swing back vertically for loading and unloading. All are of the re-circulated hot air design and are individually controlled by recording potentiometer type instruments. Parts to be heat treated are loaded in large rectangular shaped baskets of welded steel construction. Quenching is done in boiling water in 15-ft deep tanks. This is important as it has been shown that the slowest possible quench with satisfactory physical properties holds residual stresses, not later removed by aging, to a minimum. Following heat treatment, each casting goes to final inspection for Brinell hardness and for dimensional checking in massive steel fixtures.

Now a brief comment on the core department. Cores are made up in International jolt roll-over molding machines or by blowing, depending upon the size and nature of the core. Each individual piece is carefully gaged before it is accepted. Some of the core assemblies are exceedingly intricate and are composed of many pieces. One example of this is the core assembly for the cylinder head which is composed of 47 pieces. Such assemblies are made up in massive metal fixtures to assure perfection of size and alignment.

Significant to the outside observer is the evidence of constant expansion of foundry facilities within a relatively short space of time. It is not surprising, therefore, to note that the foundry is really an integration of a number of foundries under one roof. Thus

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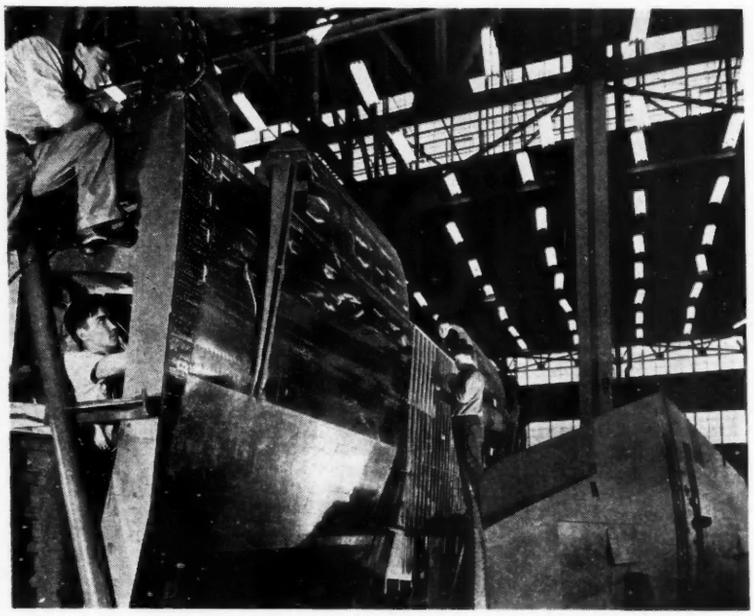


(Right) This close-up photograph shows the Curtiss Commando, the C-46, which is being produced for the Army Air Forces. Note the contrast in size between it and the Curtiss P-40 pursuit in the background.

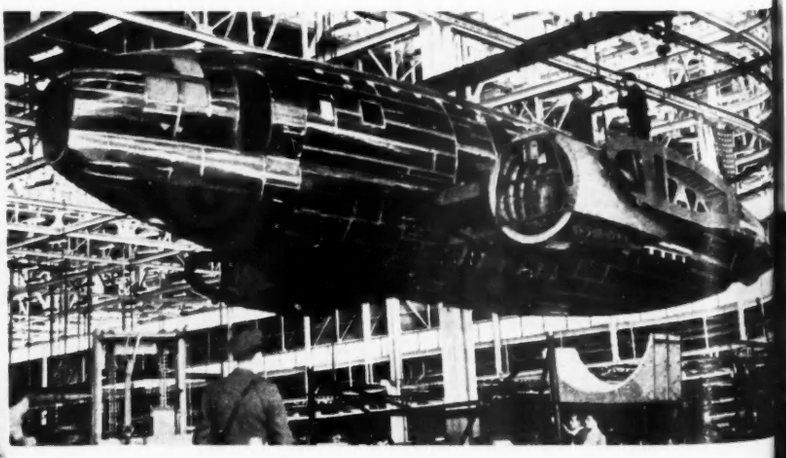
(Left) Broken down into small sub-assemblies for rapid production, the C-46 posseses unusual interchangeability of parts. At the center, workers are assembling the floor which bears the weight of artillery and other heavy equipment.

Curtiss

THE recent upsurge in the production of military cargo planes is due in part to the realization that through the use of this type, troops and equipment can be carried with dispatch and comparative safety to any fighting front. The Curtiss Commando, the C-46, developed from the CW-20 which the Army designated the C-55, is one of the mainstays of this new building program. This giant twinengine plane has a wing spread of 108 ft and weighs over 50,000 lb fully loaded. A picture of the CW-20 appeared on page 40 of the March 1 issue of AUTOMOTIVE AND AVIATION INDUSTRIES.

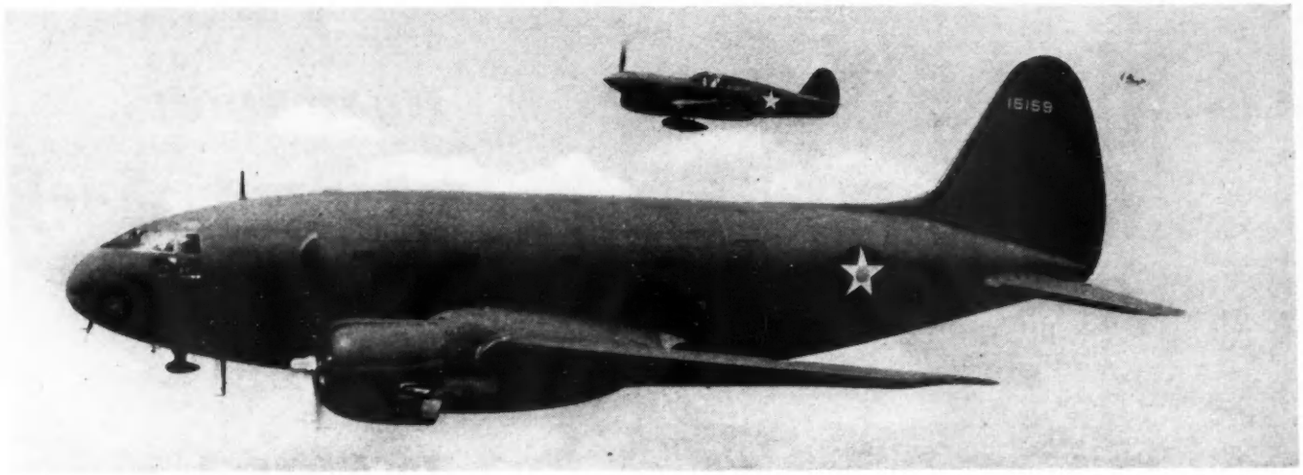
According to Curtiss officials, the C-46 is "completely lofted with fully coordinated templates." Thus, many parts are completely interchangeable. A standard wing panel, for example, will fit any plane; and since the ship can be broken down into 54 major assesmblies, line production and sub-contracting difficulties are greatly reduced.

Replaceability of parts has also been stressed.



(Above) A complete fuselage is lifted from the splicing fixture to be lowered on a movable dolly to facilitate further assembly. As shown here, the Commando's fuselage is made up of sections formed on geometrically simple lines; assembly is consequently simplified.

(Left) Curtiss mechanics check the tail unit of the 50,000-lb. Commando in pre-flight inspection. Note the contrast in size between the worker and the huge tail surface.



Commando

Giant Military Cargo Plane

Power plants, wing tips, wing panels, landing gear assemblies, control surfaces, electrical equipment, hydraulic units, and all fuel and oil tanks, can be replaced with comparative ease. Some parts are not only easily replaceable but also interchangeable. A left elevator, for instance, can be fitted on the right side. For all of these repair operations, the Army Air Forces are being supplied with the necessary trucks, hoists, and other handling equipment.

The C-46 is so designed that it can be converted in the field under service conditions from a cargo ship into either an ambulance or a troop transport. This conversion involves (1) the removal of the track installed in the fuselage for handling heavy cargo and (2) the installation of either litter racks or rows of benches, depending on the proposed use of the plane.

(Above) Some idea of the size of the Commando is shown here as a worker stands by the steerable tail wheel which operates in co-ordination with the rudder. Both the landing gear and this tail wheel are fully retractable.

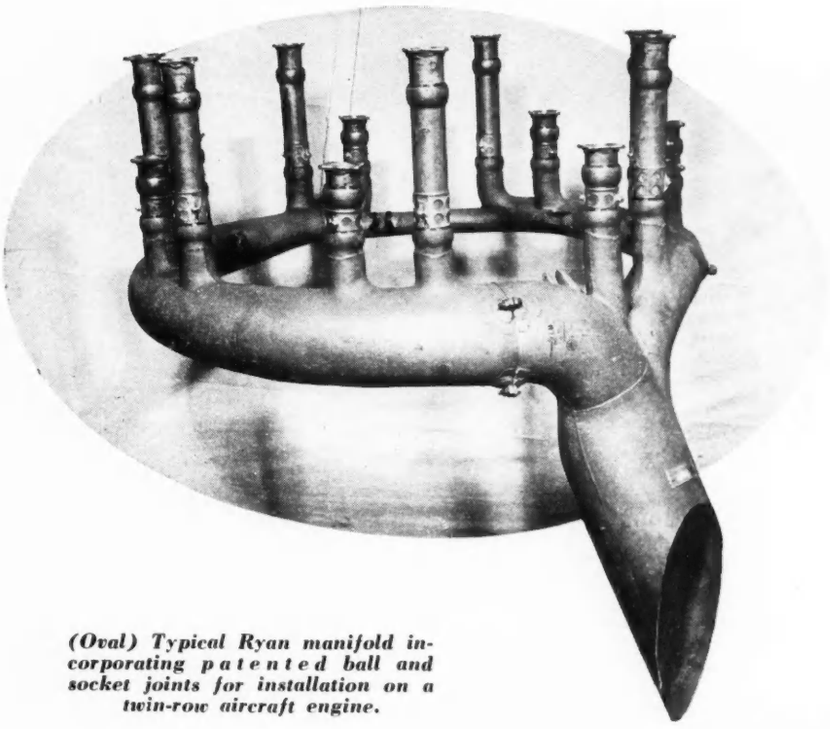
(Left) As the Commando nears completion, workers install radio equipment and seats for paratroopers.

Ryan Built

Exhaust M

By Ernest A. Moore

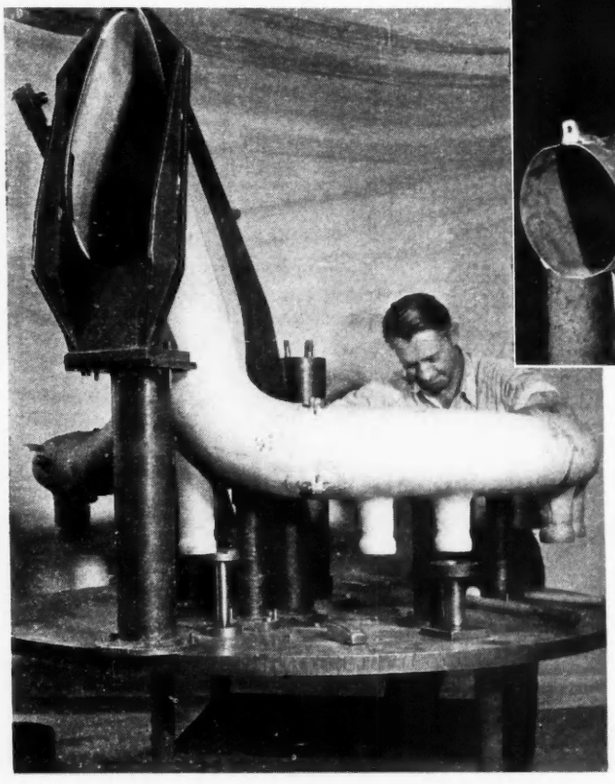
Factory Superintendent, Ryan Aeronautical Co., San Diego, Calif. This article is an abstract of a paper, "Flow Production As Applied To The Manufacturing of Aircraft Exhaust Collector Systems," which was presented by Mr. Moore at a recent meeting of the SAE Southern California Section.



(Oval) Typical Ryan manifold incorporating patented ball and socket joints for installation on a twin-row aircraft engine.

(Right) After welding on all fittings, the manifold sections are trimmed in specially developed machines.

(Below) Assembling complete manifold on accurate production jig.



DESIGN of aircraft engine manifolds has become more difficult, since often the manifold is the last part of an engine installation to be considered, and it must then be placed where space is available. The design must be such that temperatures ranging from minus 50 F to 1600 F will have no harmful effects; that supercharger pressures will be maintained, so at high altitudes the maximum horse power will be developed, and that heating units deriving their heat from the exhaust system and delivering it either to the air in the cabin or to the intake air of the carburetor system will not be unduly stressed.

The manufacture of manifolds is a highly special-

Manifolds *for Radial* Aircraft Engines

ized undertaking and requires a large amount of equipment of a type not normally found in an aircraft-manufacturing plant. Therefore, the time appears to be approaching when aircraft manufacturers no longer will consider building their own manifolds. The following is a brief description of the methods used in the manufacture of exhaust collectors and exhaust systems at the Ryan Aeronautical Co.

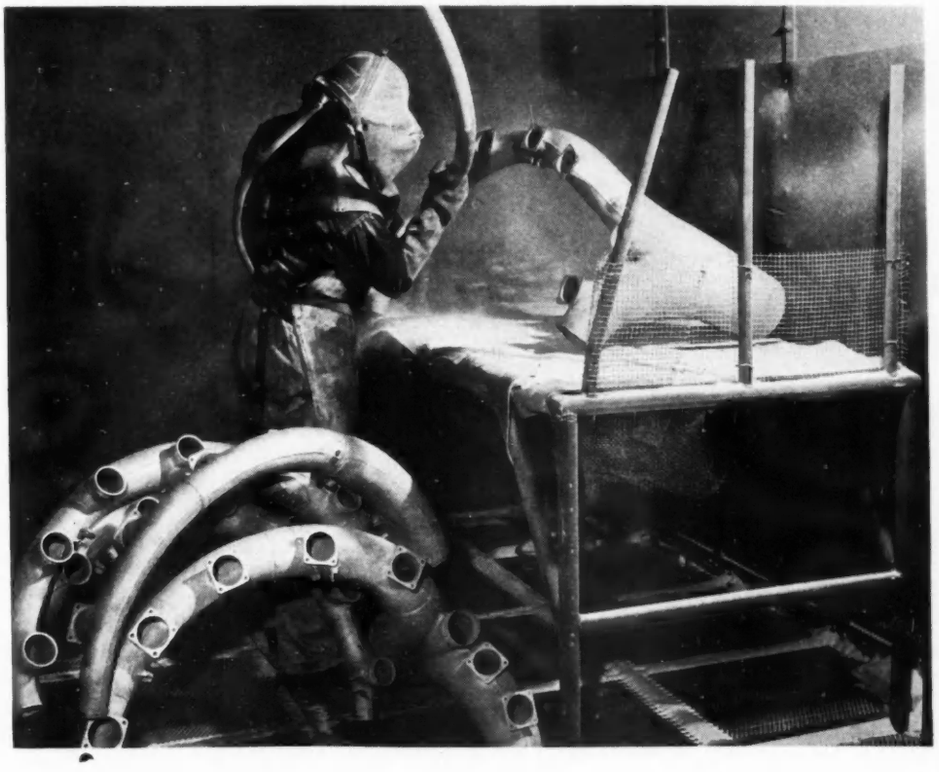
Upon approval by the manifold-engineering division, the drawings are sent to the modeling shop, where they are carefully examined with a view to deciding on production methods. Seam lines are located, and the most economical methods from the standpoint of both material and production are worked out. As part of this work, a modeling board is made which represents the seam line. The molded ring is built up on this board by means of steel templates, which are made sufficiently oversize to compensate for die shrinkage when the pattern is cast. Upon completion, a model which represents one-half of the collector is produced. A shell cast is taken from the model, and the other half is built up on this with clay.

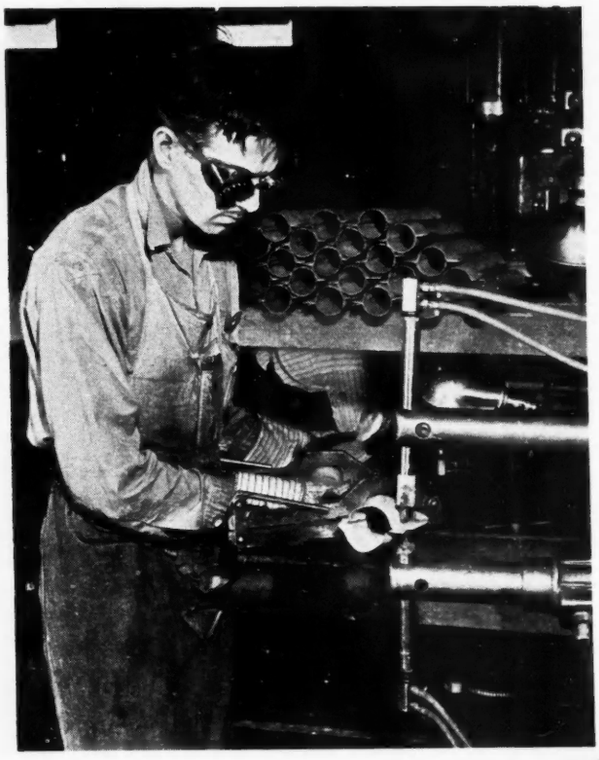
Then comes the construction of the final pattern and the casting of the die. Standard foundry methods are used for casting the dies, care being exercised to insure proper pouring temperature, etc. The punch is poured directly into the die and the latter cleared to allow for the material thickness of the stampings. While this punch is still in the form of molten metal, mounting bolts are cast into it to meet with the holes in the drop hammer head.

The next operation is the stamping of the parts. The blanks are marked for cutting by the stencil method. This consists of a network of templates fastened into a single sheet. This network of templates is carefully laid out to avoid waste of material and is of the same size as a standard sheet of stainless steel. This pattern is then placed on top of a stack of sheets and sprayed with a marking solution. After the marking is completed the material is sent to the cutting machines.

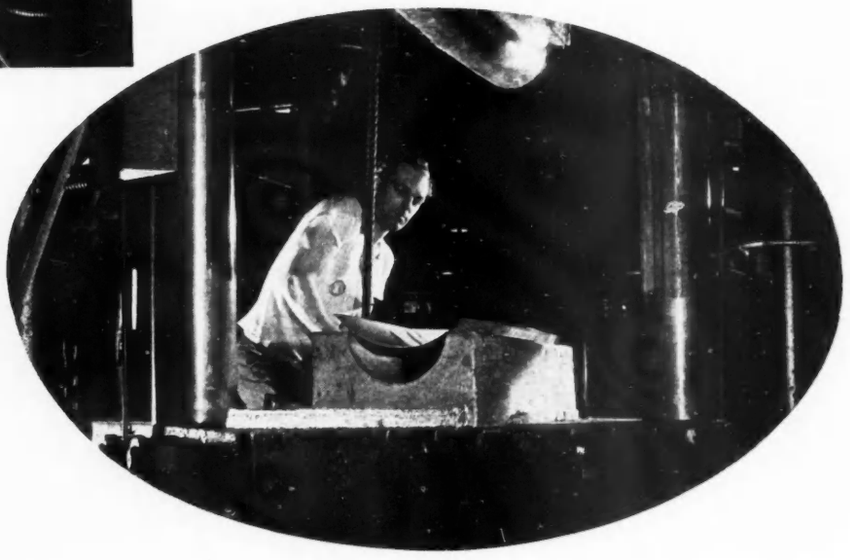
The drop hammer method is still almost universally used for manifold stamping. While the drop hammer ordinarily is not considered a production tool, if proper attention is given to die design, motion economy and mechanical handling, and to proper training of the operator, it lends itself very well to volume production.

It will be well at this point to briefly discuss the material itself, more particularly with respect to changes made in the surface finish during the past six years. Prior to the time when aircraft manufacturers began to use it in quantity for exhaust collectors, stainless steel was used chiefly for kitchenware, for dairy and food handling, and in the oil





(Above) Manifold half-section stampings are spotwelded together to form the tubes which lead from each of the engines exhaust ports.



(Oval) Fabricating half-section stamping for manifold tail pipe on Ryan-designed drop-hammer.

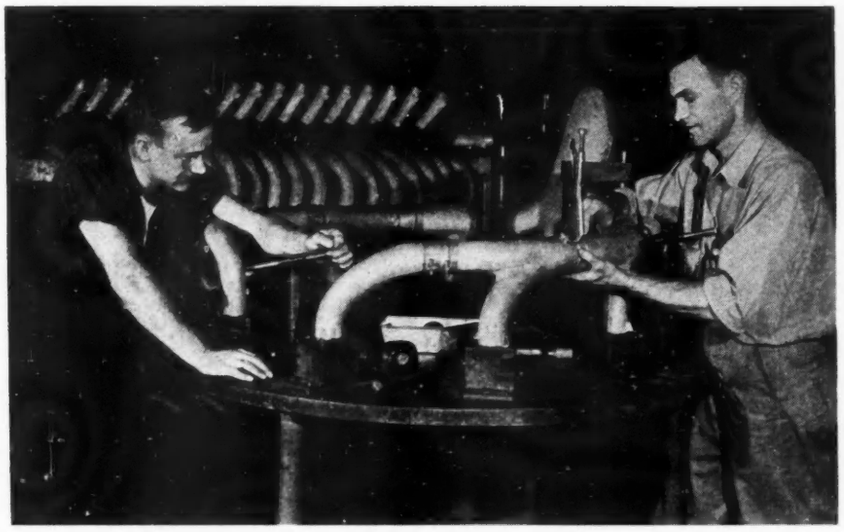
industry. A large proportion of this material was subsequently buffed and polished. The manufacturer, therefore, called for a smooth-finish sheet, to minimize buffing and polishing operations. Unfortunately, the extreme smoothness generally shortened the stamping life of the metal, requiring undue annealing and excessive scrap losses. Furthermore, it made stamping quite difficult, because the dies were unable to grasp the metal firmly and the metal would not flow uniformly. The material being received today has the surface slightly roughened by a finish-pickling operation by the steel mills, and the ductility has been increased by a modification of the basic 18-8 formula. This material, moreover, will permit of greater work-hardening before thinning out and rupture occurs.

Upon leaving the drop hammer, the stampings are loaded on a conveyor and sent through a degreasing unit. They are next passed through a nitric-acid tank, where any foreign metallic particles that may have been picked up from the dies in the stamping process or in any previous mechanical operation, are removed. This is very essential, since stainless steel possesses the property of galling readily. This surface-alloying sets up galvanic couples which quickly produce corrosion in the form of bright-colored rust spots. Following removal from the nitric-acid tank, the stampings are rinsed in hot water and conveyed directly to the annealing furnace, where the parts are annealed at 1950 deg F. The soaking time is usually quite short, from three to five minutes. No quench is required, since the material is thin enough to make air quenching effective. Upon cooling, the parts are placed on an acid-resisting basket conveyor which carries them through the pickling process. A two-stage operation possesses the further advantage that little or none of the base material is attacked by the acid. The pickling operation is completed by lowering the basket into a spray cabinet, where high-pressure jets thoroughly scrub off all remaining traces of scale. The parts now are placed on a conveyor belt, where they are inspected. This eliminates unnecessary stacking and piling, and permits a re-routing of rejected stampings, so they will not interfere with the continuous production line.

As the parts are accepted, they are conveyed to the tacking department, where mating parts are fastened together with quick-acting clamps and spot-welded at the seam. A special technique is employed in the tacking operation, so as to allow for flash trimming to proper flange height, and to prevent any unnecessary defect when the welding is later completed. The flash is trimmed with a nibbler shear specially designed for this operation.

In the welding department the parts are welded along the tacked seam by the atomic-hydrogen-welding process. This process is comparatively new in the aircraft industry and possesses several advantages over gas welding. Chief among these are the greater rapidity of welding, a sufficiently ductile weld which will permit of considerable forming, and complete absence of carbon pickup and of resultant hardening of the weld metal, which is unavoidable with oxy-acetylene welding. Ryan Aeronautical Company has so modified this method as to permit the welding of stainless steel parts without the use of a flux.

One of the most important considerations in the



Production jig setup for checking final alignment of manifolds.

welding of stainless steel is ductility of the deposited weld metal. After the seam welding has been completed, the parts are furnace-annealed to prevent any possibility of failure in the critical area adjacent to the weld, as well as to modify the grain structure in the weld metal itself.

After removal from the furnace, the parts are sandblasted, marked by means of overpressed templates, trimmed, and prepared for assembly in the jig. All welding beyond this stage is by the electric-arc method, which, it should be noted, is a distinct improvement over the former methods of gas welding.

In a manifold of the universal-joint type, where the unit sections are quite large, the limits imposed are very close, and special jigs are required which allow for distortion following welding. The parts must be held in the jig rigidly, yet they must be able to move without undue stress being imposed on the welds.

These jigs are so designed that they will allow the shrinkage that occurs in welding to draw or warp the parts into their correct position. The main body of the manifold ring, therefore, is fitted into special brackets which, while permitting the required degree of movement, still control the direction of such movement. Supplementary welding jigs incorporate the same feature.

The problem—and it is a large problem—of controlling distortion during welding was solved by the process of trial and error, and it is now possible to arrive at the required allowances between the jigs used for assembly and the jigs used for final checking. After assembly in the assembly jig and before checking on the inspection jigs, the entire unit is sandblasted. After inspection and before shipping, the completed manifold is "passivated" to increase the corrosion resistance of the metal. This "passivation" treatment consists in immersing the parts in hot nitric acid, whereby an adherent and impervious oxide film is developed on the surface of the metal.

A great many difficulties were experienced in changing from the job-shop method to "Flow Production" methods. This was due to the fact that the earlier system depended to a large extent upon the individual initiative of the department head. At present the parts are carefully engineered for production, and the tools are so planned that when the drawings are released to the loft for the master layout, the clamps, hanger parts, blanking dies for doublers and all the standard accessories, can be made ready for the jig assembly. In the tooling department, the jigs are made in sections or sub-assemblies, to permit the men, when the jigs reach production, to work around them with ease and convenience. More jigs are made of the difficult sections, in order that the sections that require more man hours to complete, may be produced as rapidly as the sections that are not so complicated. It is thus relatively easy to distribute the man hours available so as to maintain a steady flow of parts.

The problem of co-ordination is solved by using the master template to lay out all of the jigs. While the jigs are in their initial stages of construction, the

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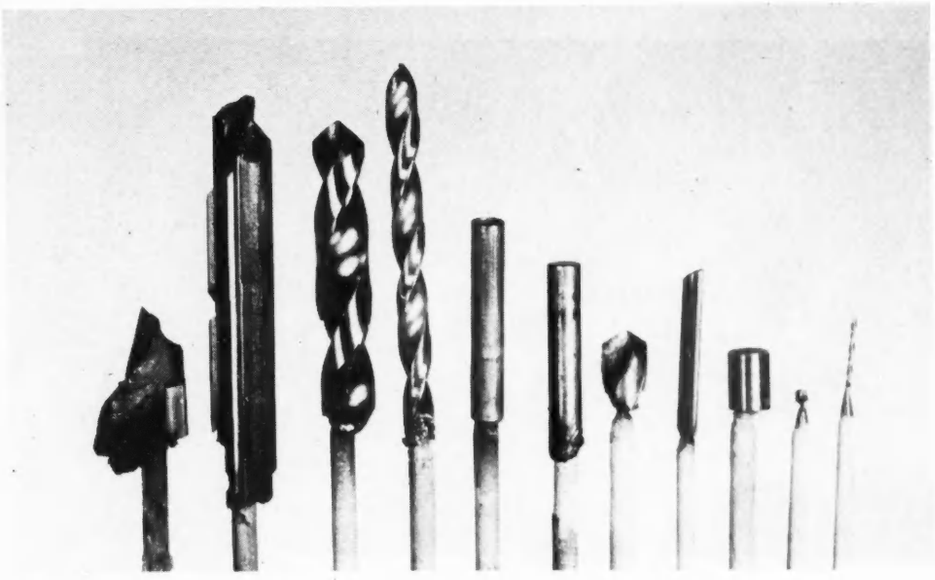
Socket connections for ball and socket installation on Ryan manifold is pneumatically hammered in special sizing machine.



Variety of broken drills, reamers and plugs removed by new method from engine parts and machine tool fixtures at Pratt & Whitney plant.

New Method for Removal of Broken Tools

ONE of the most perplexing problems in modern manufacturing—the removal of broken drills, reamers, and plug gages from drilled holes—has been solved at the Pratt & Whitney Aircraft Division of United Aircraft Corp. by developing a method of making an electric arc butt-weld between a stainless steel welding rod and the broken part, and then extracting the broken part by tapping upward on a lathe dog or clamp on the welding rod. This has replaced the methods formerly used of trying to drive or break out the broken part, piece by piece, with a prick punch and hammer. Those methods were seldom successful and frequently resulted in burred surfaces or other forms of distortion and eventual scrapping of the part.

Under the new method of removal, not only are more parts being saved from the scrap pile but the time required for the salvage operation is being constantly reduced. The scope of the work at Pratt & Whitney Aircraft covers all sections of engine crankcases, crankshafts, propeller shafts, various small parts, tools, jigs and fixtures. It is believed that the method also can be used successfully by other manufacturers.

Through the co-operation of Presto Battery Service and Industrial Welding Co., both of Hartford, Conn., tests with a-c and d-c equipment were held in order to observe the action of welding equipment in the field and to determine the most practicable type available.

A magnesium test block containing an assortment of drilled holes of varying depths into which plugs of steel were driven, was used in the demonstrations to determine whether butt welds of sufficient tensile strength could be made to withstand the force necessary to extract the steel plugs. The percentage of success in extraction from this test block was sufficient to indicate a real possibility in this method if proper technique could be developed.

In observing the action of a-c and d-c welding equipment, it appeared that less arc flashing occurred with an a-c welder than with the d-c welder. This factor

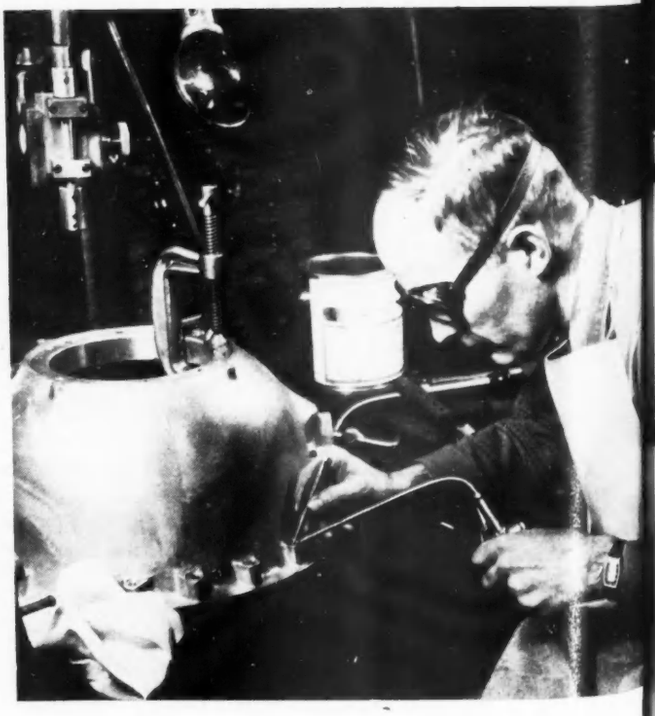


Fig. 1—Operator is preparing hole for extraction of a broken drill.

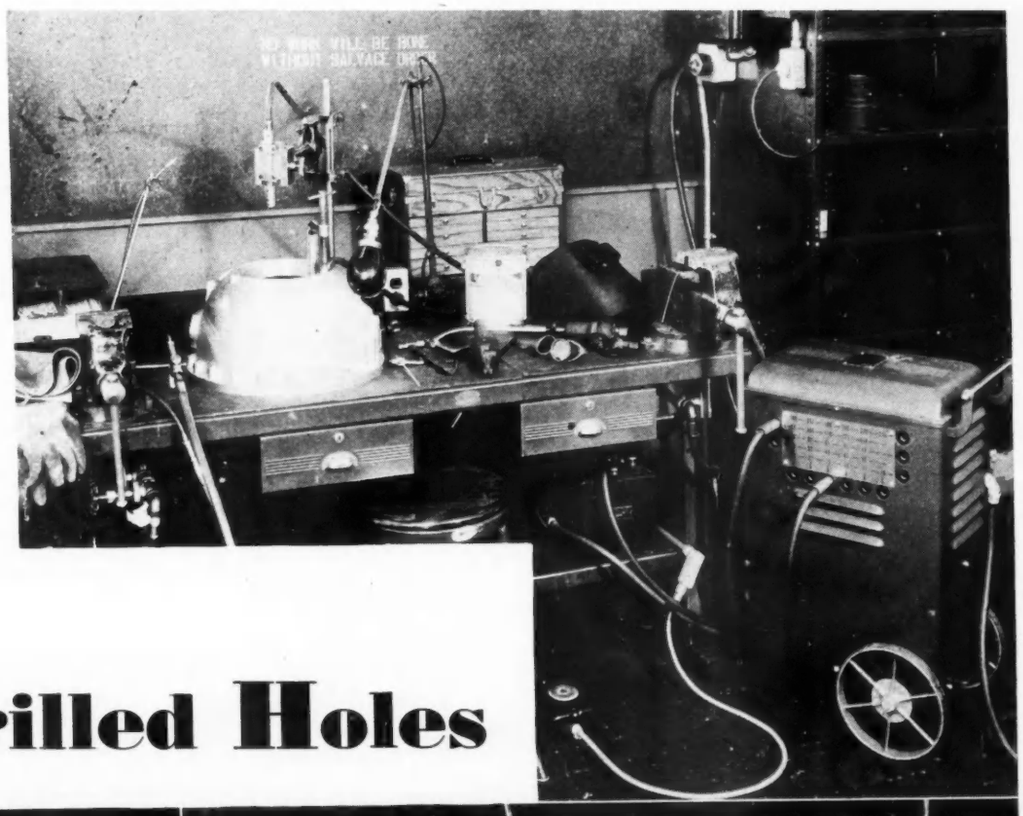


Fig. 4 — Layout of extraction apparatus.

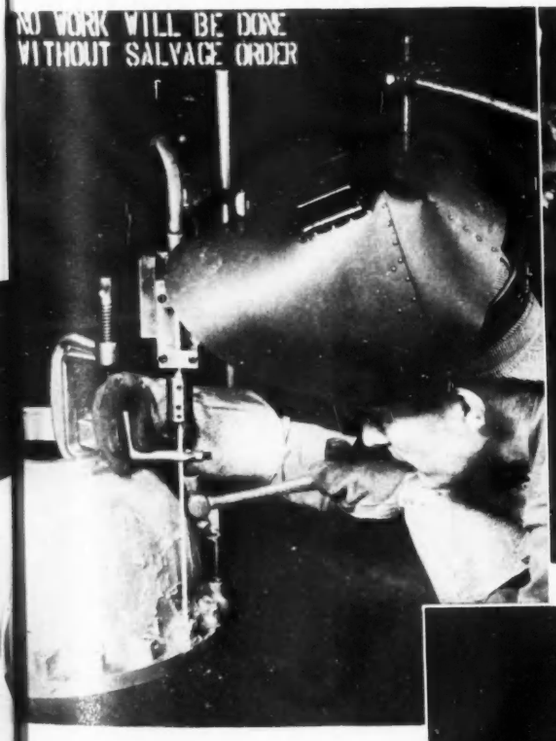
By

Henry J. Burnett

and

Charles E. Hansling

from Drilled Holes



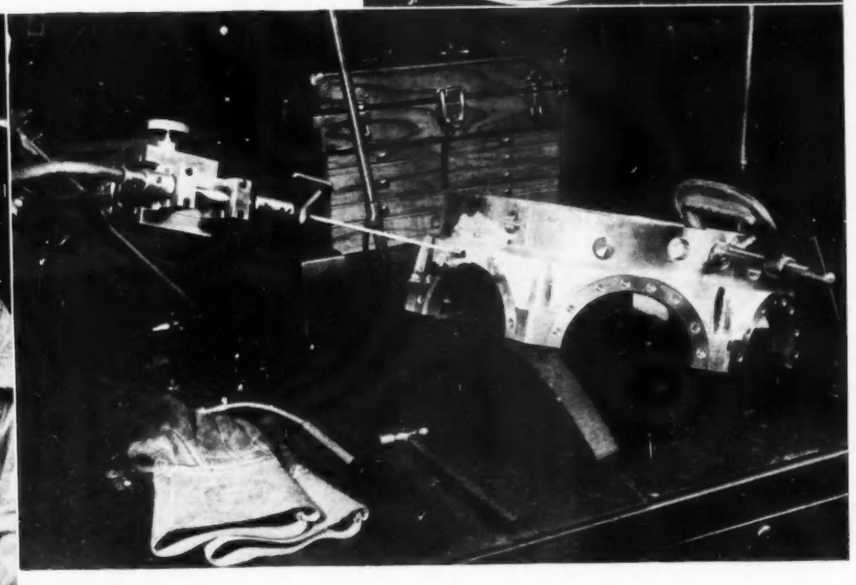


Fig. 3—Setup for removing broken pilot.

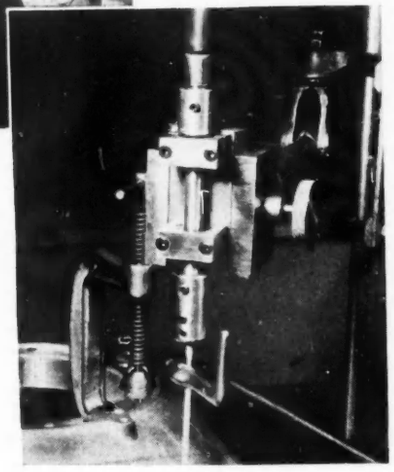


Fig. 2 — Hammer impacts are used to extract the broken drill. (Inset) The welding fixture.

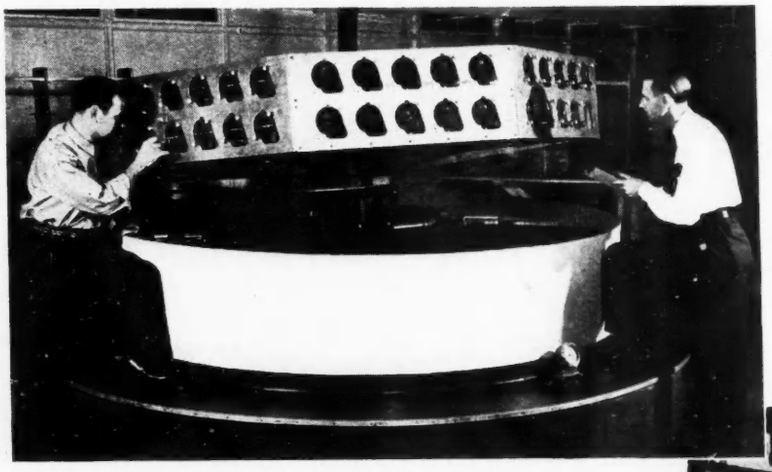
was important in that at Pratt & Whitney Aircraft most of the work involves magnesium or aluminum castings or forgings, and therefore it is advisable to avoid excessive heating or splashing of hot metal in order to positively preserve the heat treatment of these metals in the area of broken drills, and the quality of finished surfaces.

A Westinghouse a-c flex arc welder, consisting of a 20 to 250 ampere flex arc welder 220v, single phase, 60 cycle a-c, on the primary, a welding mask, cables, a welding clamp and

(*Turn to page* 88, *please*)

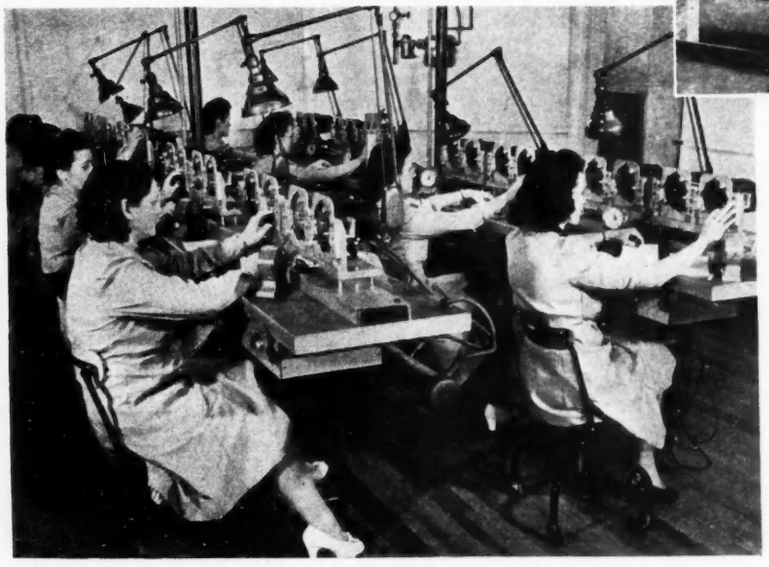
Ternstedt Now Making

MASS production of Sperry gyro horizon and directional indicators is now in full swing in Detroit at the Ternstedt plant of the General Motors Fisher Body Division months ahead of schedule, a quantity of them already having been flight tested successfully and consigned to planes for the war zones. Production of these delicate aircraft instruments is believed to be the first time a job of this nature has been undertaken by an automotive company. Fisher plants also are producing other war implements such as 30-ton tanks, bomber sections and huge anti-



(Above) This machine simulates the roll, pitch and yaw of an airplane and all instruments must perform flawlessly while it revolves.

(Right) Without being removed from the fixture, a part gets drilling, reaming and tapping operations at one of these six-spindle machines.



(Above) Each worker calibrates a bank of four instruments at one time.

(Circle) Each rotor is put through a strobometric weight inspection. They are balanced to an accuracy of .00001 oz.-in.

Aircraft Instruments

aircraft guns in their "all-out-for-war" efforts.

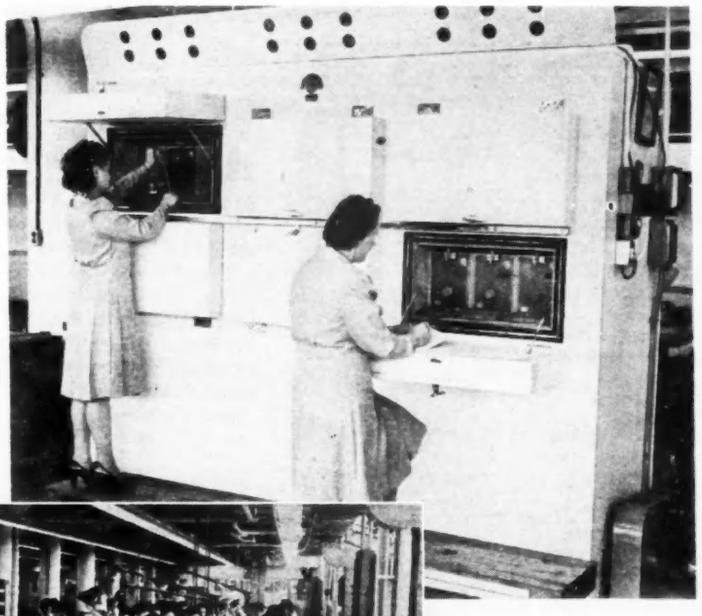
Manufacture of such instruments requires precision machining at extremely close tolerances, perfect polishing of tiny moving parts, utmost cleanliness in all mechanism, and adjustments which demand perfect balance. One tiny assembly in the instruments contains five tiny ball bearings, each of which weighs only 15/100,000ths of an ounce, and 3000 of them would fit easily into an ordinary thimble. One piece of lint or dust invisible to the naked eye can destroy the perfect function of these instruments and as a result, production must be in filtered-air rooms, and employes must wear special lint-free garments.

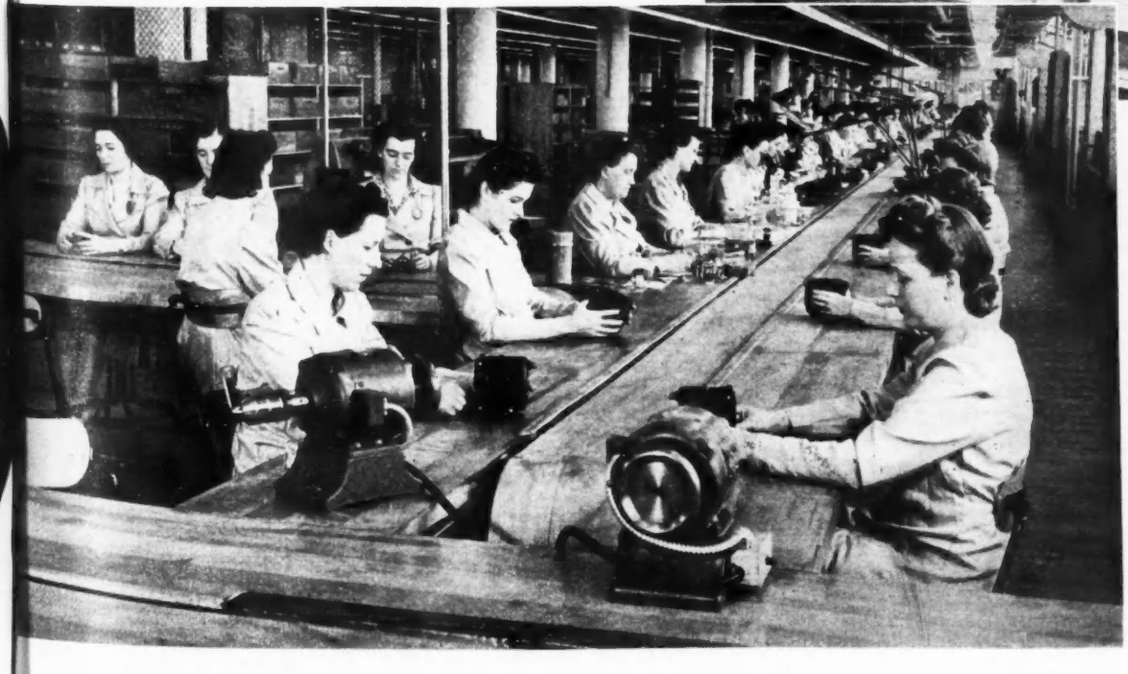
The instruments were developed by the Sperry Corp., but under the Government's greatly expanded warplane production program, Sperry manufacturing facilities were not adequate to meet the increased demand, so the Fisher Body Ternstedt Division was asked to cooperate in building of the gyro horizon and directional indicators.

When the job was undertaken, Ternstedt had only limited floor space available. No work had ever been done there before that remotely approached the precision work necessary for this job. It was assigned to a section of a plant formerly devoted to body hardware, and before work could be started it was necessary to install hospital, plumbing, air conditioning, office and laboratory facilities as well as all production equipment.

A picked crew of men was sent to the Sperry plant while physical preparations were made. At the same time the company had to muster supervision and employes, and extensive training in this type of work was required for every employe. Not a single piece of machine equipment, nor tools, gages, or precision instruments were on hand within the organization, all of them already having been delegated to other armament tasks. Some were procured with the assistance of the Sperry Corp. while others Ternstedt had to make or else find another way to do the job with the facilities at hand. Sperry drawings were used to build the fixtures. The first instruments were delivered to the Army in less than six months.

(*Turn to page* 82, *please*)





(Above) Instruments are tested in this cold chamber at minus 31 F.

(Left) Conveyor belts are used for the assembly of Army gyro horizon and directional indicators at the Ternstedt plant.

Increased War Production—Metals

DURING the week of Oct. 12 to 16, Cleveland was host to the 24th Annual Meeting of the American Society for Metals, combined with the National Metal Congress and Exposition, including annual meetings of cooperating organizations—American Welding Society, The Wire Association, and the AIMME.

Theme of this year's Congress—increased production of war products—was expressed in the exhibits, the technical sessions, and a series of 23 off-the-record discussion meetings staged by the ASM in cooperation with the War Production Board.

Living up to its past traditions, the Exposition in the Cleveland Public Auditorium, was a colorful affair boasting some 250 exhibits devoted almost exclusively to the immediate application of science and art and industry to the problems of war production. It covered so broad a scope as to defy even brief mention of individual booths. As a matter of fact, the technical men who visited the show had to confine their efforts to exhibits that more nearly touched upon their own specific problems.

The following is intended as a brief report to our readers on a sampling of the activity, with apologies

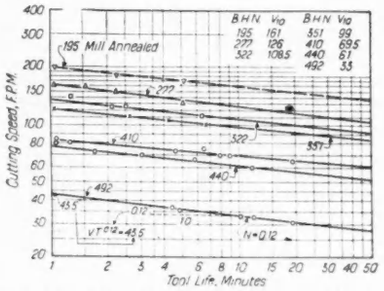
Machineability Tests

From the paper of O. W. Boston and L. V. Colwell

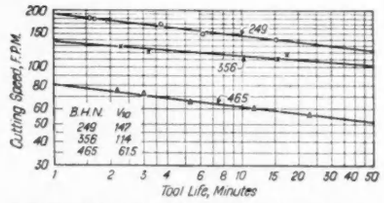
A SERIES of turning tool-life tests on S.A.E. X4345, 4645, 4145, 3145, 5145, and G.M.C. X3045A steels in the quenched and tempered condition to establish the correlation of machinability with the hardness of alloy steels, the sensitivity of machinability to hardness, particularly in the high hardness range, and the relative machinability ratings of the six types of alloy steels.

A toolroom lathe with a 14-inch swing and 24 inches between centers, was used, fitted with a Reeves variable speed drive providing speeds infinitely variable between 17 and 1200 revolutions per minute. An extra set of special feed gears permitted a selection of feeds ranging from 0.125 inch to 0.0016 inch per revolution. Tool bits ⅜ inch by 3 inch long, of the 18-4-2 type of high speed steel were used. They had the following shape:

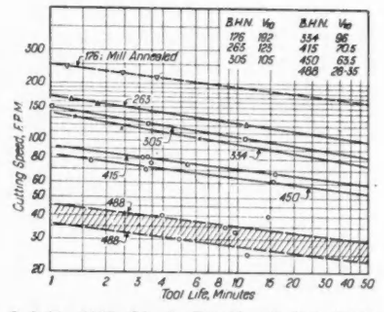
Back rake, 8 degrees, side rake, 14 degrees, front relief angle, 6 degrees, side relief angle, 6 degrees, end cutting-



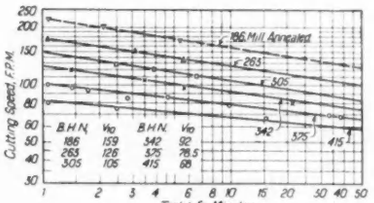
S.A.E. 4340 Steel (Modified) (First Heat)—Depth of Cut 0.050 Inch, Feed 0.0127 Inch.



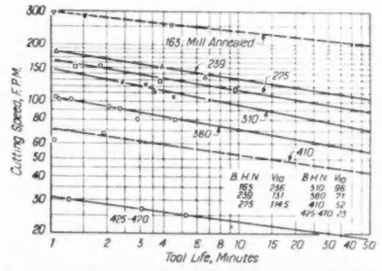
S.A.E. 4340 Steel (Modified) (Second Heat)—Depth of Cut 0.050 Inch, Feed 0.0127 Inch.



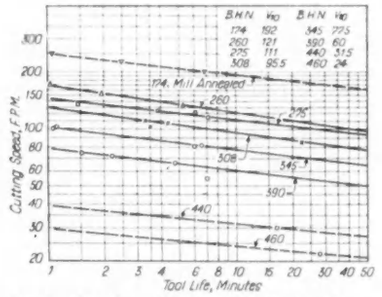
S.A.E. 4145 Steel—Depth of Cut 0.050 Inch, Feed 0.0127 Inch.



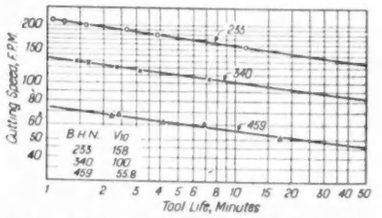
S.A.E. 4645 Steel—Depth of Cut 0.050 Inch, Feed 0.0127 Inch.



S.A.E. 5145 Steel—Depth of Cut 0.050 Inch, Feed 0.0127 Inch.



GMC X3045A Steel (First Heat)—Depth of Cut 0.050 Inch. Feed 0.0127 Inch.



GMC X3045A Steel (Second Heat)—Depth of Cut 0.050 Inch, Feed 0.0127 Inch.

By Joseph Geschelin

Theme of National Congress

for the limitations of time and space which would be required if so gigantic an event were to be suitably recorded.

To touch upon a few of the highspots, consider first the field of the special metal cutting tools. Examples of latest developments in this field were shown by a number of companies including such familiar names as Carboloy, Vascoloy-Ramet, McKenna Metals, Firth-Stirling. Closely allied with the metal cutting problem were the organizations concerned with cutting fluids and metal cleaning materials and equipment such as E. F. Houghton, D. A. Stuart, Oakite, Detroit Rex, Tide Water Associated Oil Co., Gulf, Standard Oil Co. of Ohio, J. B. Ford.

Non-destructive methods of inspection of metals, fabricated structures, and welds, were exhibited by Magnaflux Corp., General Electric X-Ray, Westinghouse X-Ray, Picker X-Ray, while du Pont featured X-Ray film and electroplating techniques and materials.

A large number of organizations contributed exhibits and literature on heat treating. Prominent in this group were the Electric Furnace Co., Surface

(*Turn to page 76, please*)

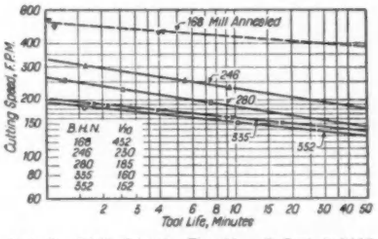
on Six Alloy Steels

Presented at the National Metal Congress

edge angle, 6 degrees, side cutting-edge angle, 15 degrees, nose radius, 3/64 inch. Tool angles were ground correct to within 20 minutes of the specified angles, and the nose radius to within 0.002 inch through the aid of special fixtures.

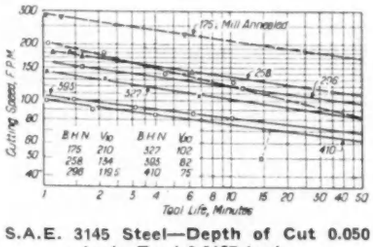
An emulsion consisting of a soluble oil was reduced with twenty parts of distilled water. Temperature was maintained between 100 and 110 degrees Fahr. by thermostats, and the stream directed on the tool face at a velocity of 358 feet per minute to give a volume of flow of 3 gallons per minute.

Two sizes of cut representing typical rough and finish turning cuts such as might be made with a turret lathe were taken so as to simulate commercial practice. The heavy or rough-turning cut was 0.050 inch deep with a feed of 0.0127 inch per revolution. The light or finish-turning cut was 0.0125 inch deep with the same feed of 0.0127 inch per revolution.

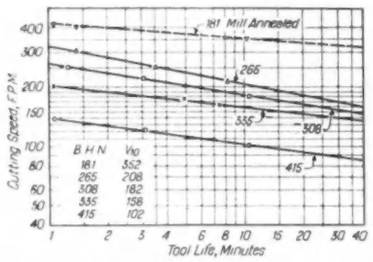


S.A.E. 5145 Steel—Depth of Cut 0.0125 Inch, Feed 0.0127 Inch.

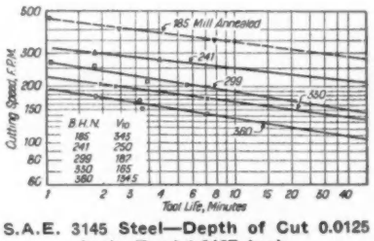
V_{10} = 10 minutes of tool life



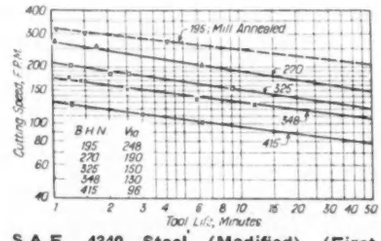
S.A.E. 3145 Steel—Depth of Cut 0.050 Inch, Feed 0.0127 Inch.



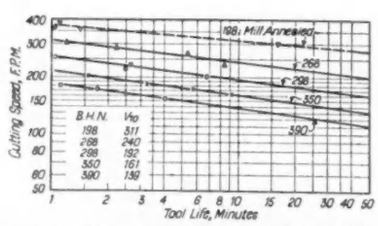
S.A.E. 4145 Steel—Depth of Cut 0.0125 Inch, Feed 0.0127 Inch.



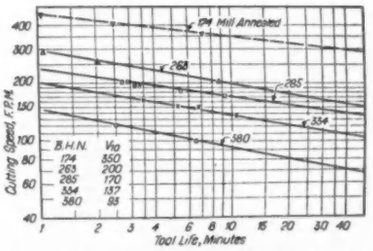
S.A.E. 3145 Steel—Depth of Cut 0.0125 Inch, Feed 0.0127 Inch.



S.A.E. 4340 Steel (Modified) (First Heat)—Depth of Cut 0.0125 Inch, Feed 0.0127 Inch.



S.A.E. 4645 Steel—Depth of Cut 0.0125 Inch, Feed 0.0127 Inch.



GMC X3045A Steel (First Heat)—Depth of Cut 0.0125 Inch, Feed 0.0127 Inch.

The Unionmelt Welding

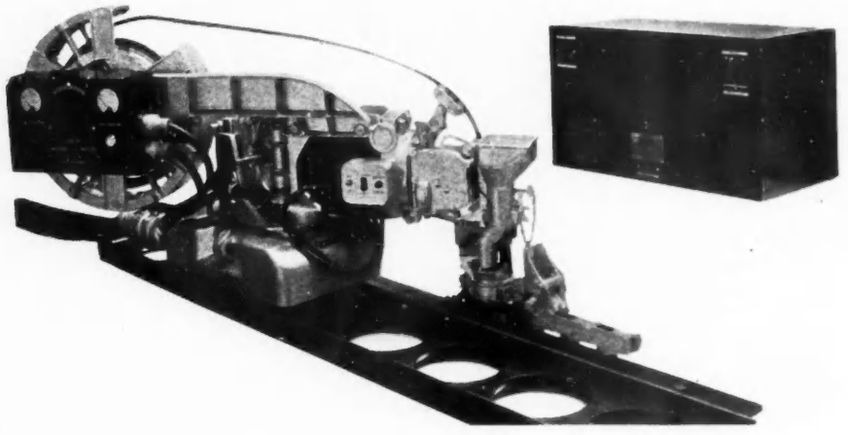
"UNIONMELT" welding is an automatic electric welding process that uses the heat generated by the passage of a heavy electric current between the workpiece and a bare welding electrode. It differs from other electric welding methods, however, in many respects and should not be confused with those processes generally classified as hand arc welding and automatic arc welding.

One of the outstanding characteristics of "Unionmelt" welding is its automatic operation. It also provides the fastest metal deposition rate of any similarly applicable welding process. Furthermore, the method makes possible the welding in one pass of metals of thicknesses that require several passes by other welding methods. For instance, butt welds are commonly made in one or two passes in any thickness of steel from 16 gage to 3 in., and at speeds ranging from 3 to 80 in. per minute. Steel up to 2½ in. in thickness is often welded in a single pass.

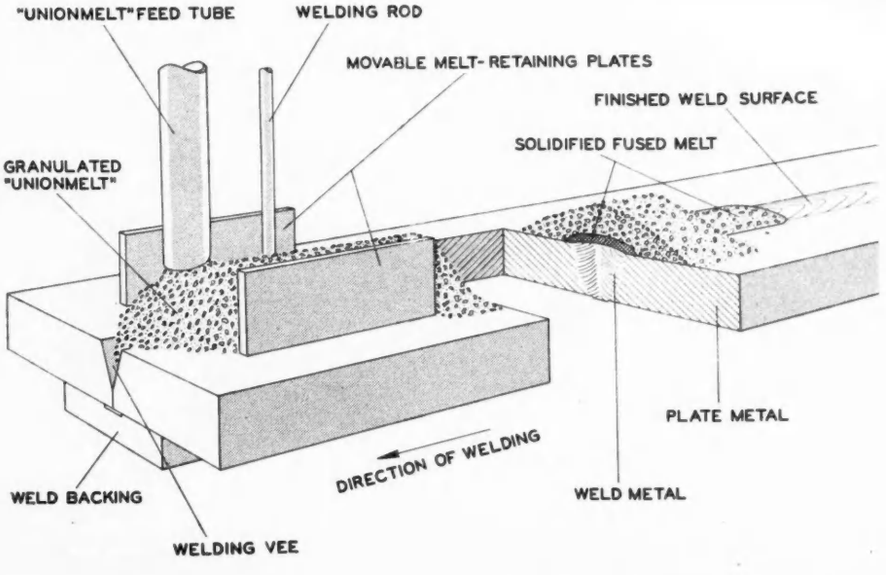
The process is used for making butt welds, fillet welds, and plug welds; and weld quality is uniformly high. A wide variety of steels, including low-carbon and medium-carbon steels, and many of the well known alloy steels with special properties of heat resistance, corrosion resistance, and high strength, have been successfully welded by this method. The process is already being widely used in many metal fabricating fields, and for such types of work as the building-up of worn surfaces and the repair of steel castings.

Description of the Process

In "Unionmelt" welding there is no visible evidence of the passage of current between the welding rod and workpiece. The welding rod is not in actual contact with the work, but the current is carried across the gap through a special granulated material known as "Unionmelt." This material, which gives the process its name, is automatically laid down along the seam to be welded and completely surrounds the end of the welding rod at all times during the welding operation. The entire welding action takes place beneath this material without an open visible arc and without sparks, spatter, smoke, or flash. The upper visible portion of



(Above) The type U head and rod reel form a complete welding unit when integrally mounted on a standard Oxweld cutting-machine carriage having variable speed control.



(Left) This sketch shows how a "Unionmelt" butt weld is made.

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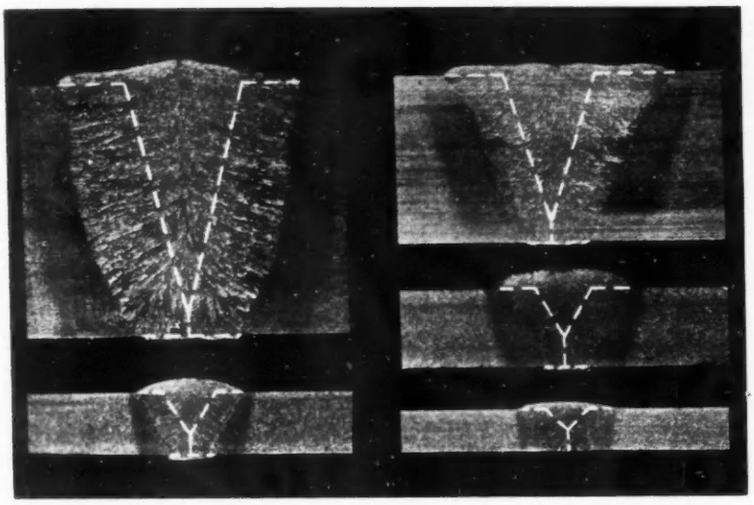
Process



These etched cross sections show one-pass "Unionmelt" butt welds in ¼-in, ⅜-inch, ½-inch, 1-inch and 1½-inch steel plate with suitable backing to insure complete penetration. The dotted lines indicate the original plate edges.

the layer of granulated "Unionmelt" is not melted but remains unchanged in appearance and properties and can be re-used. Only the lower portion of the layer melts and floats as a liquid blanket over the molten weld metal protecting it from the atmosphere and absorbing impurities.

Because of the good heat resisting properties of the molten and granulated layers of material, the intense heat is concentrated in a relatively small welding zone making possible high welding speeds—often as high as 20 times the speed of other welding methods. Unusually deep fusion into the base metal is obtained with the concentrated intense heat and consequently a relatively small and narrow welding vee can be used, requiring corresponding small addition of welding rod. As a rule, when this method of welding is used, nearly two volumes of base metal are fused for each volume of welding rod added.

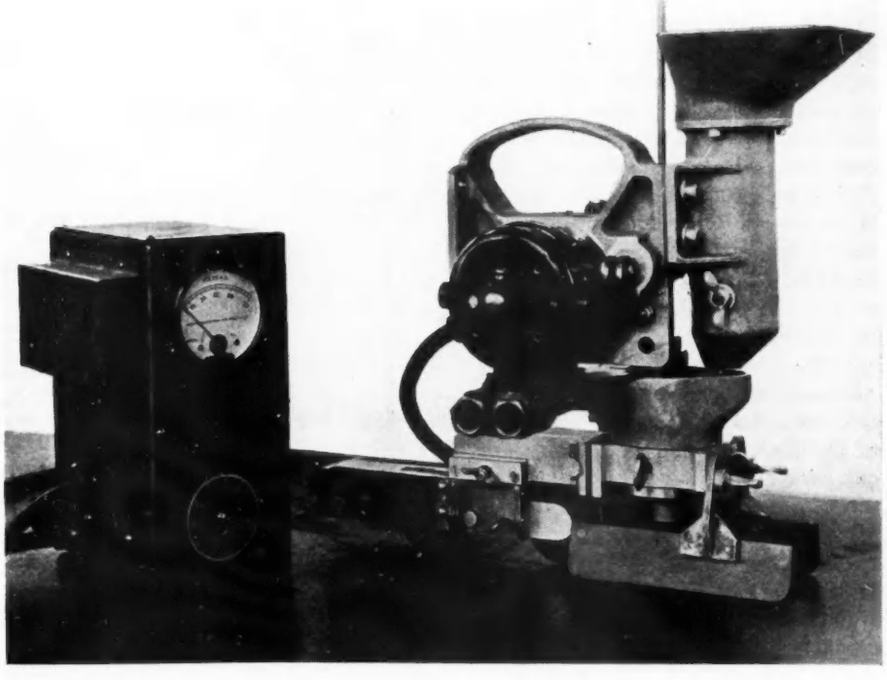
Quality of Welds

"Unionmelt" welds, made under the protective layers of "Unionmelt" material, washed by intimate contact with the overlaying molten layer, and allowed to solidify while still protected, can be expected to have superior quality. The welds have unusual strength, ductility, shock resistance, uniformity, density, and corrosion resistance. Physical properties are as good as, and often better than, those of the base metal.

"Unionmelt" Equipment

For welding by the "Unionmelt" method a specially designed unit or welding head is required. This head performs a threefold function: it progressively deposits "Unionmelt" granules along the welding vee; it automatically feeds welding rod into the welding zone; and it transmits the electric current to the welding rod. The granulated material is ordinarily supplied from a hopper either mounted directly on the head or connected to the head by tubing. The bare welding rod is fed into the head in straight lengths or from a coil of rod mounted on a

(*Turn to page* 84, *please*)



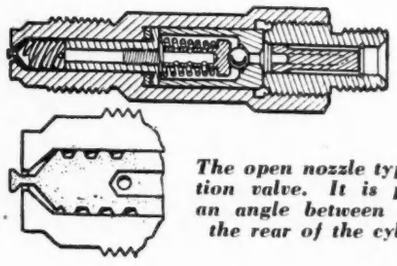
The Type S "Unionmelt" welding head is small and readily portable. It can be mounted on any suitable carriage or support.

The

Part Two

Part One appeared in the October 15, 1942, issue of AUTOMOTIVE *and* AVIATION INDUSTRIES.

THE barrels of the injection pump are a light push fit in their housings and are held frictionally therein by a light spring ring of channel section, located approximately at the middle of their length. During assembly they can be turned around their axes to bring their ports into the correct angular position, by means of a pin wrench whose pins engage in drill holes in the top face of the barrel. Once properly adjusted, the barrel is fixed in position by means of a sleeve nut, which also holds the delivery valve in place. There are two oppositely-located ports in the barrel, an inlet port and a spill port, at slightly different levels. Injection ceases when the large land on the plunger uncovers the spill port and allows the fuel remaining in the barrel to return to the annular space forming the suction chamber. It will be seen that both the upper and the lower edge of the land on the plunger are helical, so that both the beginning and the end of injection vary simultaneously, an earlier cut-off being accompanied by a later start of injection. With a gasoline engine, of course, injection is effected comparatively early during the compression stroke, and injection timing is not nearly as critical as in a Diesel engine. From the cutaway view of the pump barrel it will be seen that an oil grove is cut in its bore at about the middle of its length, to which fuel oil is admitted through holes drilled in the barrel. This is done with a view to ensuring effective lubrication of the plunger. The control shaft, which carries the pinion meshing with one of the sleeve pinions for the control of the injection quantity, is operated automatically from the central control unit. Part of the width of the pinion on the control shaft is cut away to make room for a stop pin which limits the angular motion of the pinion, and, therefore, the maximum amount of fuel which can be injected.

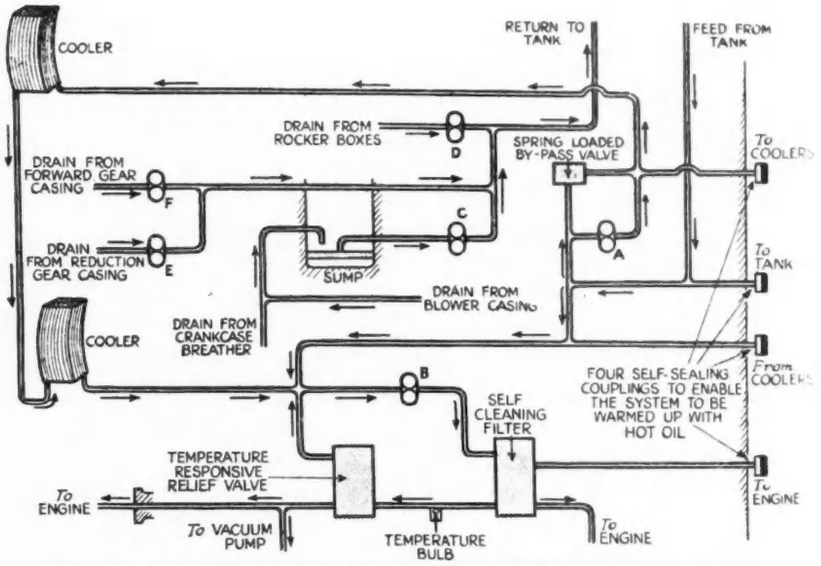


The open nozzle type fuel injection valve. It is positioned at an angle between the ports at the rear of the cylinder head.

At its lower end the pump plunger carries a cup-shaped spring retainer which encloses a floating, self-aligning pad or block against which the head of the tappet bears. Owing to the form of the cam lobes, whose generatrices are not parallel with each other, the tappet roller is profiled or cone-shaped. With a conical roller there naturally is some side thrust, and this is provided for by forming the bronze bushing of the roller with a flange on which the thrust is taken. A radial oil groove is cut in each side of this flange.

The cam plate is telescoped and riveted to a flange on the splined drive shaft and has a bearing on the bronze bushing pressed in place on the reduced end of the tappet-housing half of the pump body. A large-diameter ball thrust bearing is formed between the cam plate and the mounting flange of the injection pump, both of which have races or grooves for the balls turned in them. In the mounting flange there is also an oil seal for the drive shaft.

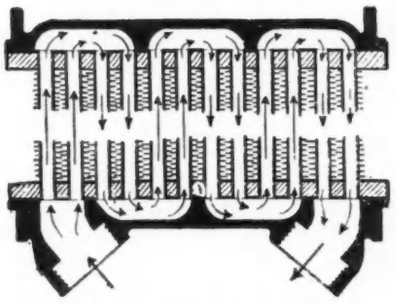
Rotation of the tappets around their axis, and consequent misalignment of the rollers with the cam lobes, is prevented by providing the former with a segmental extension whose ground edges bear against a split ring carried by the pump body concentric with the cam plate. Oil from the engine lubrication system is supplied to the injection-pump mechanism through drill holes in the mounting flange and the pump body.



Schematic arrangement of high-pressure lubrication system. Two pressure pumps, A and B, and four scavenge pumps, C, D, E and F, are employed.

BMW 801A Aircraft Engine

The injector nozzles are of the open type and are provided with a core, on the inner end of which a three-lead worm thread is cut to give a swirling motion to the fuel as it emerges from the nozzle. A pin or pintle extends through the nozzle orifice, and is provided with a conical head of only 0.008 in. diameter. The core is held in position in the nozzle by means of a flange on its outer end, which is clamped between a shoulder in the nozzle bore and the thimble-shaped housing for the ball-type check valve. Pressure is exerted on this housing by screwing home the threaded fuel connector at the outer end of the injector. A washer between the flange on the core and the shoulder in the nozzle serves as a means of adjusting the distance the pintle head protrudes from the nozzle orifice. Inside the connector is located a tiny fuel filter, consisting of a cylindrical metal plug which has a helical groove 0.004 in. deep cut in its outer surface. Fuel enters the filter through two diametrically-opposite longitudinal groves which extend from the outer to near the inner end of the plug, and then passes through the shallow helical grooves to two other, intermediate grooves which extend from near the outer to the inner end of the plug. From these latter the fuel passes through the ball check valve and through drill holes into the hollow stem of the spring-loaded valve plunger, which latter is concentric with the axially-drilled core of the nozzle. From the bottom of the axial hole in the nozzle the fuel passes through three radial holes into the three helical tooth spaces of the worm. The core is a close fit in the nozzle and is provided with an internal thread to take a withdrawing tool. Injection nozzles are screwed into bronze bushings in the cylinder head at the rear side between the two ports.



Diagrammatic section showing direction of flow through the multi-tube, nose-mounted oil coolers.

Secured to the rear of the pump is a pendulum-type of de-aerator consisting of a housing adapted to swing around a hollow shaft through which the separated air escapes. Air trapped in the centrifugal de-aerator, together with a certain amount of fuel, is delivered into the pendulum de-aerator, and after a further separating treatment in this device the fuel returns through the fire-bulkhead filter cock to the suction line of the fuel transfer pump. Air separated in the pendulum de-aerator, together with what little fuel it may contain, is returned to the fuel tank. On the upper part of the pendulum of the separator there is a sliding cork float which controls ports in a tubular member of the pendulum. Whenever the fuel level in the de-aerator chamber reaches a certain level, the float closes ports in the tubular member and prevents the escape of fuel. This de-aerator evidently is equally effective regardless of the attitude of the plane.

To permit quick dumping of the fuel supply in an emergency, or rapid transfer of fuel from the reserve to the service tank, a compressed air connection is provided on the auxiliary-gear casing, by which means compressed air from the blower can be admitted to the tank or tanks to be emptied.

Readings of the fuel pressure can be made on a pressure gage, for which a connection is provided on the transfer pump. The transfer pressure can be adjusted by means of a regulator valve working on the by-pass principle, excess fuel being returned to the suction side of the transfer pump. The adjustment is made by a slotted screw which when turned right-handedly increases the pressure, and vice versa. The engine-driven fuel pump is provided with a by-pass valve on each suction side, to permit of the use of the hand pump to de-aerate the line and compress the fuel for starting the engine.

Lubrication of the engine is by high-pressure dry-sump system. As shown in the schematic diagram herewith, two pressure pumps, A and B, draw oil from the tank. Pump A puts the oil under a pressure of 180 psi and forces it through the two oil coolers in the nose of the cowling, the two coolers being connected in series. The pressure is regulated by the conventional relief valve, which places the delivery side of the pump in communication with the suction side as soon as the pressure rises above that for which the valve is set. From the coolers the oil returns to the common inlet pipe of the two pumps. Pump B forces oil through an edge-type self-cleaning filter, the cleaning element of which is driven from the pump shaft at a reduction ratio of 1040 to 1. Connected across the inlets to the two pressure pumps and the filter is a temperature-sensitive relief valve which, after the system has reached its normal working temperature, maintains the oil in the main distributing gallery at a pressure of 125 psi. As long as the engine is comparatively cold, the relief valve is more highly loaded, and oil can be supplied to the engine bearings at higher pressure, up to 220 psi. A check valve in the oil line behind the self-cleaning filter prevents oil from draining out of the engine when the latter is shut down.

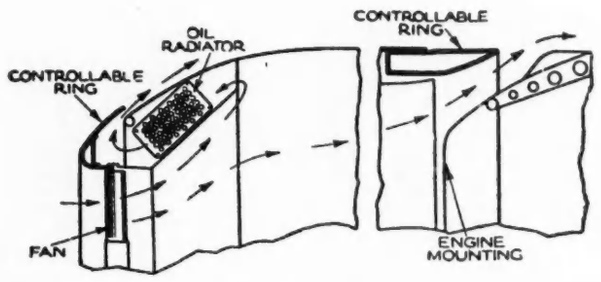


Diagram showing the air-flow in the cowling. The sliding gill rings are each operated by an electric jack.

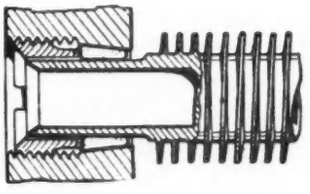
Oil draining from the blower and the oil separator collects in the oil sump, which is scavenged by pump C. The oil separator, which is secured to the side of the tubular mounting ring, consists of a cylindrical chamber into which oil vapors from the crankcase and oil tank are discharged through a tube extending into it axially. The air there is separated from the oil by means of a stack of perforated metal plates which trap the oil and allow the air to escape to the atmosphere.

The system comprises no less than four scavenging pumps. Pump D scavenges the valve-rocker housings; pump E, the reduction-gear housing, and pump F, the forward gear housing. All four scavenging pumps return oil to the tank through a common pipe.

An interesting feature of the powerplant is the oil cooler, which consists of two segmental units lodged between a conical sheet-metal extension of the fan shroud and the nose of the cowling. As shown by one of the sketches, air drawn in by the fan enters the space between the sheet-metal cone and the cowling at the rear, flows forward through the coolers, and is discharged through the slot between the nose ring and the cowling. Each half of the cooler consists of 60 finned light-metal tubes of 0.295 in. inside diameter, which are arranged in 12 staggered rows of five tubes each. The tubes are approximately 43 in. long and are detachably secured into the tube plates, also of light alloy, to which the cover plates are bolted. Oil enters the cooler at one of the cover plates, passes through two rows of tubes in parallel to the opposite cover plate, returns through the next two rows, then passes back and forth twice more through the remaining tubes, and finally leaves through the same cover plate through which it entered, as shown by one of the sketches.

Another drawing illustrates the detachable connection between the finned tubes and the tube plate. The end of the tube, which is smooth on the outside, enters a hole in the tube plate which is machined to a taper over about one-half its length and screw-threaded over the other half. A tapered packing ring of soft aluminum is passed over the end of the tube and forced into intimate contact with the tapered bore by a threaded bushing screwed into the hole from the outer end. To prevent scoring of the soft aluminum ring, a steel washer is inserted between it and the threaded bushing. In the design of the oil cooler, the same as in that of other units, the evident aim has been to make it as compact as possible, and the tubes of the cooler are very closely spaced. Their diameter over the fins is 0.67 in. and they are spaced 0.73 in. in the rows, which latter are only 0.63 in. apart.

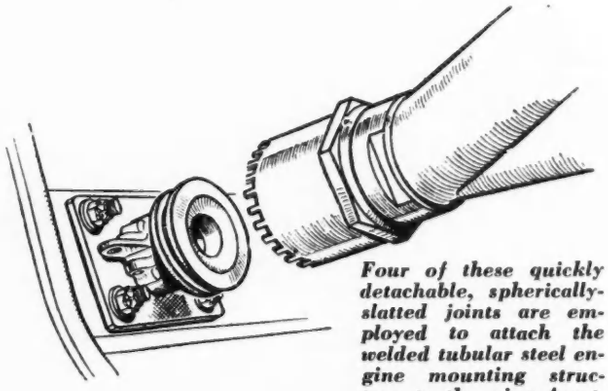
To facilitate mounting and dismounting of the engine, the connections to the oil gages of both the pressure and scavenging systems are arranged on a junction ring secured to the engine mounting ring, so that they are permanently secured to the air frame. The cooler is filled and blown off by pumping hot oil through it, or, if necessary, oil diluted with fuel.



Oil cooler tubes are secured by a tapered bushing and a screwed ferrule.

The reduction gear is of the planetary type, with six planetary pinions. The ring gear of the planetary assembly is driven from the crankshaft through a gear-type coupling; the sun pinion is fixed, and the planetary carrier, which is the driven member and has the propeller shaft secured to it, rotates in the same direction as the crankshaft, at reduced speed. In some installations the propeller turns in the opposite direction to the crankshaft. In that case the sun pinion is made the driving member, the planetary pinions turn on studs fixed in space, and the ring gear has the propeller secured to it.

At its rear end the propeller shaft is supported in a lead-bronze bushing in the hollow crankshaft, while at the forward end of the reduction-gear housing it is supported by a large ball bearing which also takes the propeller thrust. From the descriptions it is not quite clear whether this is a deep-groove or an angular-contact ball bearing. One of the internal gears of the pitch-changing mechanism is keyed to the propeller shaft, while the other internal gear and the blade-operating gear are loose on that shaft. Where the shaft leaves the gear case, the bearing is sealed by a junk ring with two spring packing rings inside the pitch-changing sleeve. There are oil-return grooves on the outside of the sleeve. The front end of the



Four of these quickly detachable, spherically-slatted joints are employed to attach the welded tubular steel engine mounting structure to the wing front.

sleeve is splined to receive the VDM variable-pitch propeller, and threaded for the propeller-hub retaining nut.

Also located within the forward gear case are the pitch-changing mechanism and the drive for the cooling fan, which latter is taken from the propeller-shaft gear through a pair of intermediate gears connected by a flexible shaft, to the fan driving gear. The cooling fan, which turns at 3.2 times crankshaft speed, is supported in two roller bearings in the front cover of the gear case. An oil groove with drain hole to the gear case is provided in the outer end of the bearing hub.

The engine is elastically mounted on the airframe by means of a tubular-steel mounting structure which is clearly shown in the cutaway view of the engine assembly. The tubular structure is connected to fittings on the front spar of the airplane wing by means of spherically-seated connectors, of which a sketch is shown herewith. A large slotted nut serves to draw the parts of the connector together, and is locked by means of a spring-loaded pin. At the front the tubes of the mounting structure are secured to a tubular-steel ring by means of four rubber-bushed bolts. This ring is fastened to the channel-section, light-alloy mounting ring back of the blower casing by ten rubber mounting blocks. Four of these blocks are at the top, four at the bottom and one on each side.

This concludes the description of the BMW 801A begun in the Oct. 15 issue.

Why Automotive Manufacturers Prefer Balanced Flow

(Continued from page 17)

easily with the material available.

The complete supply of materials available should not be fully absorbed in production schedules for any given period. Instead, a cushion of 3 to 5 per cent to take care of contingencies should be set aside by the government. This would leave material available for emergency requirements, upward adjustments in original production schedules due to changing strategic requirements, new devices and adjustments which might be necessary during any transition from the present material control procedure to the Balanced Flow plan.

The Balanced Flow plan takes away the incentive from a manufacturer of ordering more materials than are needed to complete his schedule. His inventories are limited and so are his total output unless he can make more efficient use of the materials he is allotted. It has been suggested that companies be awarded Army-Navy production "E's" for the most efficient use of the materials available, not for total quantity produced, which has resulted in a wild scramble for materials under the priorities system now in force. The Balanced Flow plan also is regarded as more flexible in permitting the curtailment of some war product and increasing the schedule of another product, with a consequent shift in material ordered. Necessary production changes, improvements or new products can be put into effect more promptly with changing strategic requirements.

The Steel Budget plan involves a multitude of paper work before the material certifications are obtained. The manufacturer must justify his material requirements before he can place the orders to get his allocations. One automotive company estimated that it would have to process two million pieces of paper for one year's war production. Under the Balanced Flow plan, the manufacturer justifies his material orders while production is under way. However, the success of this plan depends upon the proper scheduling of production. There is no additional burden on the small company, which must get its allocation of material as a subcontractor from the prime contractor under the Steel Budget plan. The latter means more record keeping and red tape.

The Balanced Flow plan was inspired when the priorities plan of material control broke down in recent months. The priorities plan was satisfactory as long as war production deliveries were a minor percentage of the nation's productive capacity. But with U. S. industry now operating on an all-out war basis and the automotive industry, as an example, devoted more than 95 per cent to war production, the priorities system has proved inadequate. Essential steel requirements as revealed by the Production Requirements plan now more than absorb the entire steel productive capacity of the country.

Under PRP, war contractors are getting varying percentages of their material requirements, with a resultant unbalance in production and fewer finished products. As an example, one military truck manufacturer received only 50 per cent of the copper required by a particular contract, but he obtained 80 per cent of the alloy steel and 90 per cent of the carbon steel required. Thus his production was cut in half by the limitation imposed by the copper available. Subcontractors may have similar inequalities in material available that could prove a further handicap to meeting production schedules. Meanwhile, the truck contractor's steel might be tied up in partially finished vehicles whereas its use elsewhere might expedite the war effort. The gearing of production to materials available under the Balanced Flow plan is designed to minimize this situation.

Shortages of carbon, alloy and stainless steel, copper and copper base alloys and zinc have compelled WPB to cut requirements considerably on those materials during the current fourth quarter. Thus under PRP the output of the finished products will be controlled by the lowest authorized quantity of any material available unless a successful substitution can be made and approved by the appropriate authorities.

The Production Requirements Plan has been so snarled in red tape that many manufacturers could not get their PD-25-A applications for fourth quarter material processed until well into October, so they were operating on a "blind" basis, so to speak.

To bring some order into the chaotic situation, Kanzler as director general of operations sent out a statement of policy to cover the emergency. It follows in part:

"It has not been found possible to cut materials authorizations to companies making parts in exactly the same proportion as authorizations to companies making the finished products in which the parts will be used. It is, therefore, of vital importance to the war program that all companies affected should promptly make their own adjustments so that scarce materials will not be put into process during the fourth quarter to make parts or subassemblies which are not immediately needed for end products. . . . If parts manufacturers find that they will be unable to make the quantity of finished parts they had expected to make, they should immediately contact their customers so that arrangements can be made to maintain the highest possible end-product production."

It is recognized that any new material control plan cannot be put into effect by WPB until the second quarter of 1943.

New Production

THE King-Seeley Corp., Ann Arbor, Mich., announces a new full-flow oil filter. It is designed for direct installation in the engine crankcase, is gear driven, and provides for continuous self-cleaning and self-flushing. The accumulated sludge and filtering residue is returned to a sump in the oil pan. The degree of refinement in filtering can be determined by selection and spacing of the proper gage wire on the filtering cage.

Another King-Seeley development is a new hydraulic-type governor and servo unit which amplifies and transmits the speed-regulating forces produced in the centrifugal governing unit. This new design is said to provide exceptional stability and positive throttle action at the governed speeds.

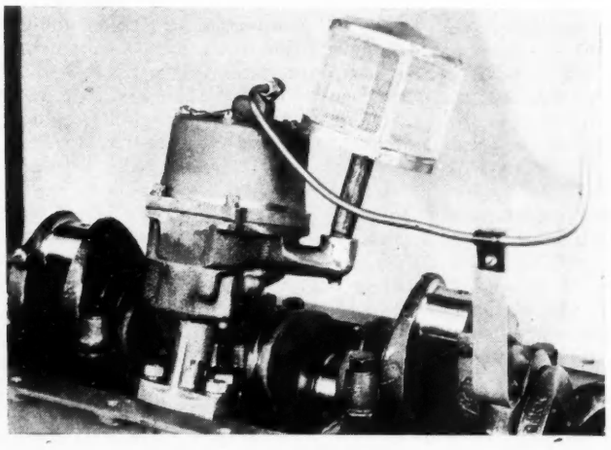
Denison 100 ton hydrOILic press.

A MULTI-PURPOSE, open-side press, adaptable to pressing, assembling or straightening operations, has been announced as an addition to the line of HydrOILic presses of the Denison Engineering Co., Columbus, Ohio. This press is of 100-ton capacity and is designated by its manufacturer as model DLOS2-100. It is available with either a guided platen or a threaded ram. Either manual or electrical control is available and dual control hand tie-up can be furnished.

The maximum stroke of the ram and the maximum throat opening are each 18 in. The vertical opening is 36 in. The width, at the base, is 64 in. and the depth is 40 in. The unit is 11 ft, 6 in. high.

AN outside diameter cylindrical finishing machine having a wide variety of applications in the production of war material is now being built by Hammond Machinery Builders, Inc., Kalamazoo, Mich. One of a number of ways in which the machine can be arranged is by using for the polishing member a special wheel with "Auto-Doper" adapted to the particular work. This machine may also be arranged with backstand idler pulley and patented segment face contact wheel permitting use of surface-coated abrasive belts which run over the face of the wheel and to the back stand, for polishing and finishing on many materials and shapes of articles previously beyond their scope.

The machine is designed with a range of feed of zero to 50 fpm for 1 in. diameter, forward or reverse. A quick release lever provides control of the work being fed through the machine by disengaging the work from the face of the wheel. The work support is easily adjusted to the wheel for work of varying diameters and can be supplied either in the standard type or of a special design to suit the customer's requirements.



King-Seeley full flow oil filter.

THE new W. F. and John Barnes 445 independent, two-spindle, deep hole drilling and boring machine is designed to drill or bore two parts simultaneously in completely independent cycles. Each workpiece is driven by independent headstocks and is supported by separate steady rests. The tools are fed by independent hydraulically actuated slides.

The machine base is in two sections, with three ways running full length. The head section has tee slots milled into the center way for clamping the headstock and steady rests to the ways. Other sliding members are clamped to the two outside ways by gibs bolted to the under side of each member. Each headstock can be positioned at any place along the head base, by loosening the tee slot bolts and clamp gibs. Independent type, four jaw chucks 15 in. in diameter are normally furnished with the machines, but chucks up to 24 in. in diameter may be used.

The screw adjustment for each of the three rollers of the steady rests permits the handling of work from 5 in. to 16 in. in diameter.

Two quill type tailstocks are manually advanced, by rack and pinion, by means of levers at the top of the quill support brackets. Moving these levers toward a vertical position clamps the quills in place. The whip supports and tool holders are mounted on accurately scraped ways. Springing of tool shanks at the start of the work cycle is prevented by guide bushings in the whip supports.

Two motor-driven hydraulic feed and traverse units mounted at the head end of the machine actuate the hydraulic feed cylinders mounted in the base. The machine may be controlled from each of four push-button stations, two on either side of the machine at the side of the head and at the center of the machine.

A NEW machine, known as the TOCCO Junior, is announced by the TOCCO division of the Ohio Crankshaft Co., Cleveland, Ohio. This machine, which is automatic except for the loading and unloading of parts, is designed especially for surface hardening the wearing surfaces of rocker arm shafts of automotive engines. The oper-

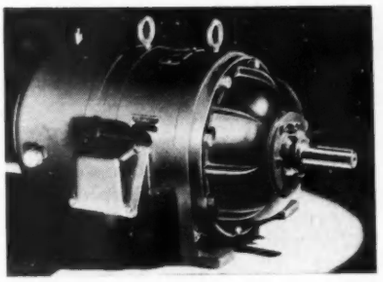
Equipment

ation is as follows: Rocker arm shafts to be hardened are placed in a fixture which guides them into an electric inductor. When a shaft arrives at the proper position, high frequency electric current is turned on automatically, raising the temperature of the surface to be heated. After a calculated interval, the electric current is shut off automatically and the heated area quenched in a spray of water. Indexing mechanisms permit the shafts to travel through the fixtures and stop at regular intervals. The high temperature is confined to the surface to be hardened, thus keeping distortion to an absolute minimum.

A NEW heavy duty control station switch is announced by the Electrical Manufacturing Division of The National Acme Co., Cleveland, Ohio. This unit is said to be universal enough to meet the voltage and amperage requirements of practically all heavy duty installations. Standard assemblies consist of 3, 2 or 1 button combinations, furnished either in flush type for mounting in standard cavity, or box type for surface or pendant mounting. Push or turn type station buttons are optional and are interchangeable for top, center or bottom to suit convenience of individual standard. The standard button markings are: Stop, Start, For. and Rev. Other indicia such as Slow, Fast, etc., will be supplied on special order.

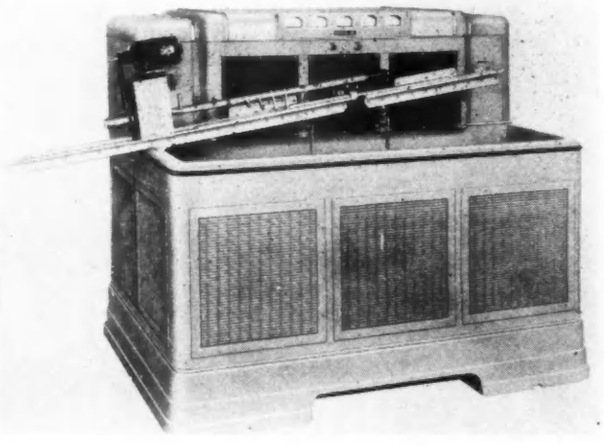
A LINE of totally enclosed induction motors for use under hazardous metal-dust conditions, is being offered by the General Electric Co., Schenectady, N. Y. These motors were developed to meet a need brought about by the extensive use of magnesium and aluminum in war production. They are so designed that no dust which might cause an internal explosion can enter the motor and no external parts will become hot enough under permissible overloads to cause ignition of surrounding dust. Listed and labeled by the Underwriters' Laboratories, Inc., for Class II, Group E locations, these motors have been subjected to severe testing in combustible-dust atmospheres and are suitable for use wherever combustible metals are being handled in powder form or where machining, grinding or polishing operations are performed and dust tight motors are necessary.

FOR degreasing surfaces of aircraft parts or equipment too large to be cleaned by tank immersion or washing-machine methods, a number of airplane and automotive plants use steam-detergent methods. Of interest in this connection is the recent development by

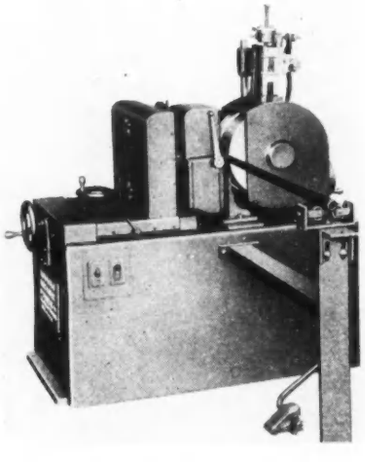


GE totally enclosed, fan cooled induction motor.

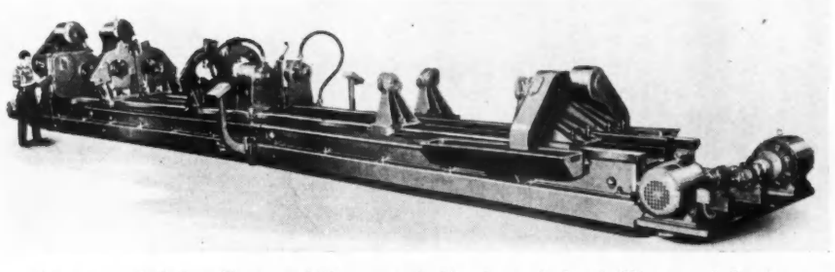
New National-Acme Heavy Duty Snap-Lock Control Station Switch.



Tocco Junior machine for hardening the wearing areas only on rocker arm shafts.



Hammond "OD" Cylindrical Polisher.

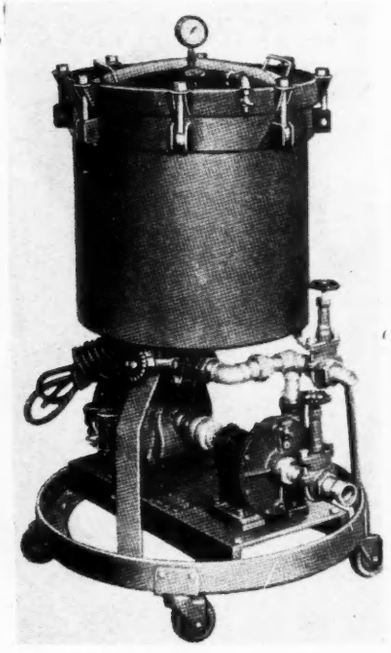


W. F. and John Barnes 445 two-spindle deep hole drilling and boring machine.

Oakite Products, Inc., New York, of an improved steam-detergent cleaning gun known as the Oakite Solution-Lifting steam gun.

Aside from its low weight and ease of use, this steam detergent gun offers the advantage that it automatically lifts the cleaning solution from the floor or other low level to a working height of 12 ft without the usual auxiliary apparatus. All that is needed to operate this steam gun is a source of steam at 30 psi pressure or more, steam and solution hoses, and an open container for the cleaning solution.

A LINE of horizontal plate filters is being offered by the Sparkler Manufacturing Co., Mundelein, Ill., in various sizes, having capacities of from 5 to 10,000 gal per hour. These units feature horizontal filter plates, nested on top of each other, and totally enclosed. The filter cake lies in a flat, horizontal position so that the filtering process is straight downward only. To meet particular conditions imposed by the filtering of grinding or cutting oils, plating solutions, etc., they are built of iron, aluminum, bronze, monel metal, stainless steel, rubber lined, lead covered, and semi-hard rubber.

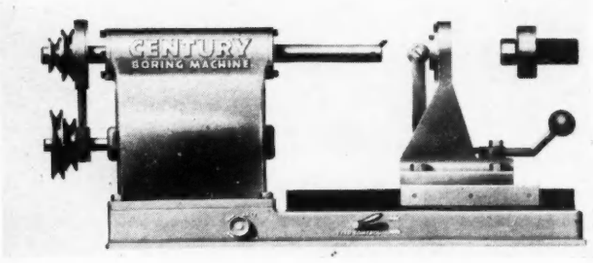


Sparkler Filter No. 18-S-12 with a capacity of 1000 gals. per hour.

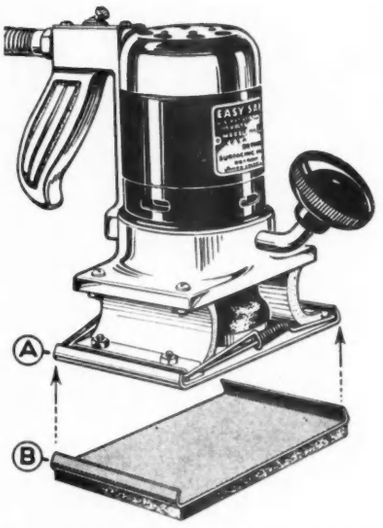
A NEW type bench model precision boring machine is announced by the Century Engineering Company, Los Angeles, Cal. The machine will bore holes from ⅜ in. to 2¾ in. in diameter and the makers state that it will bore to tolerances of a few ten thousandths of an inch. Parts which have parallel sides adjacent to the hole are held in place by a quick acting fixture which is furnished with the machine. This fixture may be removed and other fixtures, for holding unsymmetrical parts, attached to the slide, which is air and hydraulically operated. A small hydraulic metering valve controls the speed of the fixture on the slide, which moves the work slowly toward the boring bar during the boring operation and retracts it quickly when the cutting operation has been completed. The 110 v motor, which drives the spindle, is housed within the lower part of the spindle casting.

A NEW arc etching machine is now being built by the George Gorton Machine Co., Racine, Wis. It is known as the New Gorton "Spit-Fire" Electric Arc Etching machine, Model A-E and is designed for either high production or individual marking of soft or hard metals, including the hardest steels. It is said to be exceptionally efficient on highly polished and ground surfaces and for marking goods in the finished state. The etching is done by a very small tungsten wire electrode, oscillated 120 times per second by a magnetic motor. Each time the electrode touches and leaves the work, a high-amperage electric circuit is made and broken, creating an extremely hot arc. As the electrode is moved over the work, by the pantograph, a steady succession of small, overlapping craters form the etching. Depth is controlled by the amount of current, width by the diameter of the electrode. The moving intermittent electric arc removes the metal by decomposition, leaving a clearly legible mark. The extension arm is designed so that work may be handled in previously inaccessible places, such as inside a cylinder, cavity, or along both sides of a V-block, etc.

New Gorton "Spit-Fire" Electric Arc Etching Machine.



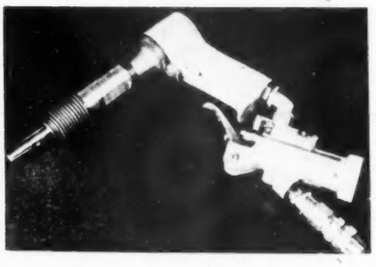
The new Century bench model precision boring machine.



Detroit Surfacing sanding machine with quick detachable bottom plate.

DESIGNED to facilitate quick changing of abrasives and pads, a new electric sanding machine, known as the Model XLD, is being made by the Detroit Surfacing Machine Co., Detroit, Mich.

This model features a detachable bottom plate which is the part to which the felt, rubber or composition sanding pad is secured and over which the abrasive is attached. In previous models the pads were fixed to the machine and quick changes were not possible. This new type plate permits instant removal of one type or size pad and installation of another. Detachable bottom plates are available with pads of sponge rubber, felt or composition in widths from 1 in. to 3¾ in. and ¼ to 1 in. thick.



The Murray Time-Air for control of riveting time cycle.

THE manufacturing and selling rights have been purchased by the Chicago Pneumatic Tool Co., New York City, on the newly developed Murray Time-Air, a device which automatically controls the time cycle of pneumatic riveting guns. The Time-Air is a light, compact unit which is designed to be attached to the handle of a riveting gun and may be controlled by the operator, either automatically or manually. Employed automatically, the trigger is depressed fully and the timer delivers a pre-determined time cycle and then stops. This insures uniform riveting when several rivets are driven in sequence.

When the trigger is pulled back slightly, the hammer operates as long as the trigger is held in this position, permitting trim-up or an occasional longer cycle, or the trigger can be released at any time, providing for a trim-up cycle.

Time cycles are set by turning a small adjustment dial, and pressure control may be regulated for thin or soft material.

A TRIO of matched assembly line units has just been announced by the Aviation Division, Whiting Corporation, Harvey, Ill. The ETN group, as they are called, is designed to facilitate the handling and moving of any radial aircraft engine from the time it leaves its packing case through the final stage of the engine nacelle build-up.

The three matched pieces of equipment include the following: Model E engine cleaning stand, which supports the engine for all initial operations and preliminary assembly of accessories; Model T engine transfer carriage which fits into Models E or N to simplify shifting of engine from one unit to the other, and Model N rotatable nacelle build-up unit which provides a support for the final assembly of accessories, plumbing, wiring, etc.

These units are available with varying capacities for all sizes of large radial engines.

A PORTABLE machine for degreasing 20 to 75 mm shell casings is being made by the Phillips Manufacturing Co., Chicago, Ill. It employs a conveyor belt, equipped with carrier basket-pockets, to automatically place the shells in position for forcing a special solvent into the shell interiors. Solvent injection is at an angle which avoids the formation of air pockets. No steam, water or gas connections are required as the solvent is heated, and its temperature controlled, electrically.

DESIGNED to facilitate pre-flight checking of the hydraulic circuits of planes, a portable hydraulic test bench has been announced by Hydraulic Machinery, Inc., Detroit, Mich. This test bench is equipped with a compressor, hydraulically operated, for charging hydraulic accumulators and a variable displacement pump, with an adjustable pressure range of zero to 1000 psi, for operating the hydraulic circuit at various speeds. It can also be used for pumping fluid into or out of the plane.

All of the controls are labeled and are easily accessible from the outside of the unit. A vise is mounted on the hardwood top and a built-in drawer is provided.

THE Hevi Duty Electric Co., Milwaukee, Wis., has introduced a new gas cracking unit, known as the model HD 824. This unit is designed to produce a protective atmosphere for use during the heat treatment of alloy and high carbon steels, particularly those containing molybdenum. It is normally operated in conjunction with the Hevi Duty gas preparation machine which uses manufactured, natural or bottled gas. It may be used with high pressure blower air only to produce one definite gas analysis.

The maker states that the cracking unit will produce an atmosphere high in carbon monoxide (20-35 per cent), free from carbon dioxide, and with controlled amount of hydrogen, depending upon the dew point of the combusted gas as introduced into the unit. For certain types of tool steels, a high carbon monoxide content of the protective gas is desirable with a minimum of hydrogen or water vapor to prevent decarburization or scaling. This machine will produce an ideal protective gas for such steels since the percentage of carbon monoxide gas may be varied and the percentage of hydrogen reduced to a minimum.

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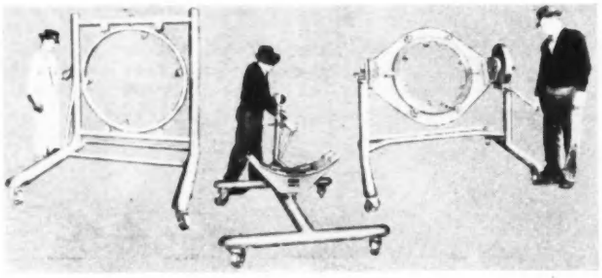
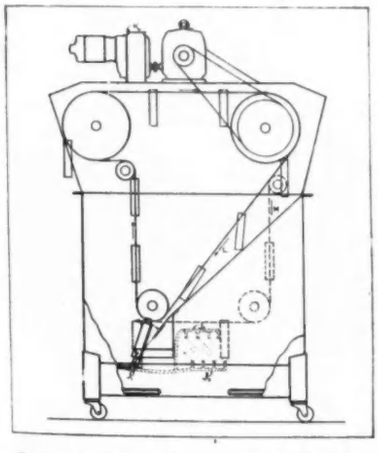
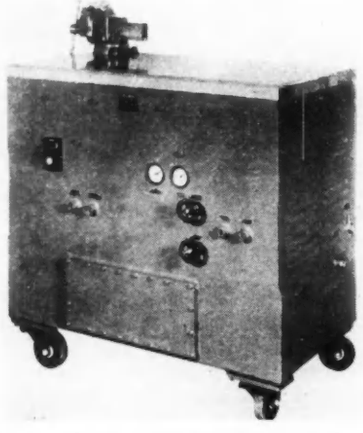


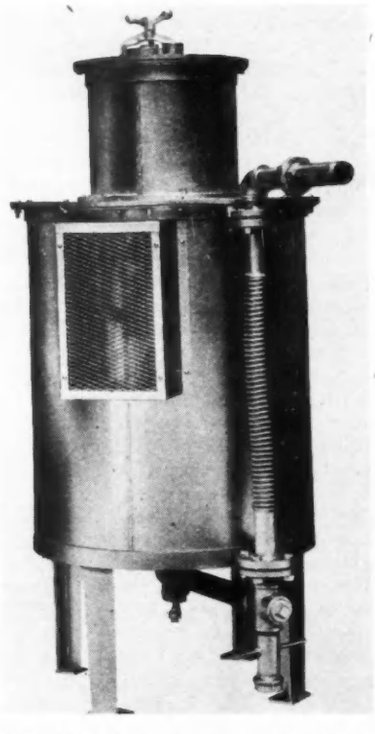
Whiting matched assembly line units for radial engines.



Construction diagram of Phillips Automatic Shell Degreaser.



Portable Hydraulic Test Bench.



HD 824 Hevi Duty Gas Cracking Unit.

Our Tanks and Tank Production As Viewed by Our Ordnance Chief

Output boosted by Group Efforts on Plate Fabrication; ACPW's Record in Aircraft Equipment Volume

No. 1 objective of the Ordnance Dept. in its tank building program is to standardize on a single engine for the medium tank, Maj.-Gen. Levin H. Campbell, Jr., chief of ordnance, asserted on his first visit to the new Tank-Automotive Center at Detroit recently. It has been impossible to standardize on an engine for the M-4 medium tank because production schedules call for so many units that facilities have not been available for manufacturing that many engines of a single type. Four types of engines are being used in the M-4 tank—the Wright Whirlwind made by Continental Motors Corp., the General Motors twin diesel, the Chrysler multi-bank composed of five six-cylinder Chrysler automobile engines and the Ford V-8 liquid-cooled engine. Gen. Campbell said the "Big Three" of the automobile industry were agreeable to standardizing on any one of the engines which the Ordnance Dept. decided was best. Fuel economy, endurance, ease of service and general experience in maneuvers and combat will decide the eventual choice of a standard powerplant for the M-4.

Answering a recent criticism by a Russian army officer, who said the American M-3 tanks were too high off the ground, had tread too narrow for swampy Soviet terrain, were vulnerable to gasoline fires and had too many trimmings designed for the comfort of the occupants, Gen. Campbell said the first two causes of criticism already have been remedied in the newer M-4 model, which has a lower silhouette and wider tracks. The chief of ordnance said all tanks are equipped with automatic fire smothering devices that put out blazes caused by hits on either gasoline or diesel fuel. The biggest fire hazard in tanks, said the general, is a hit on the ammunition supply. He dismissed the criticism of too much comfort as being overdrawn. Padding and other improvements are designed to make it easier for tank crews and to improve their efficiency.

Gen. Campbell said a few heavy tanks (60-ton type) were being built but improvements in the armor and the firepower of the M-4 made it unlikely that many of the heavier units would be turned out. The tank is an offensive weapon and a lighter tank like the 30-ton M-4 proves faster and more maneuverable. It also uses less material and is easier to transport overseas. The Army has decided to standardize on a light tank (under 15 tons) made by an automotive manufacturer, and has found this unit very reliable. Tank production is ahead of schedule, according to the general. He had praise for the Automotive Council for War Production, asserting that it is doing a "grand job" in coordinating the production of armaments. He said the Ordnance

(*Turn to page 64, please*)

War Production Meeting Held by A.S.T.E.

Some 1000 Tool Engineers from all over the nation assembled in Springfield, Mass., Oct. 16 and 17, for the War Production Conference held by the American Society of Tool Engineers, the largest meeting of production engineers ever held by this technical organization in the fall.

Condensed to a total time of two days, the meeting arranged by a committee headed by Frank Curtis, chief engineer, Milling Machines Div., Van Norman Machine Tool Company, was featured by three technical sessions on each of the two days.

Friday's sessions were devoted to subjects relating to training of labor, inspection methods, and tool conservation. On Saturday two simultaneous sessions on war tooling in the morning were followed by a conference on materials substitution in the afternoon. At the banquet on Saturday night, Thomas S. Beck was chief speaker.

Ickes and Eastman To Talk to A.P.I.

The twenty-third annual meeting of the American Petroleum Institute, to be held at Chicago, Nov. 9 to 12, will be addressed by Petroleum Coordinator Harold L. Ickes, Deputy Coordinator Ralph K. Davies, and the seventeen assistant deputies, special assistants and directors of OPC divisions.

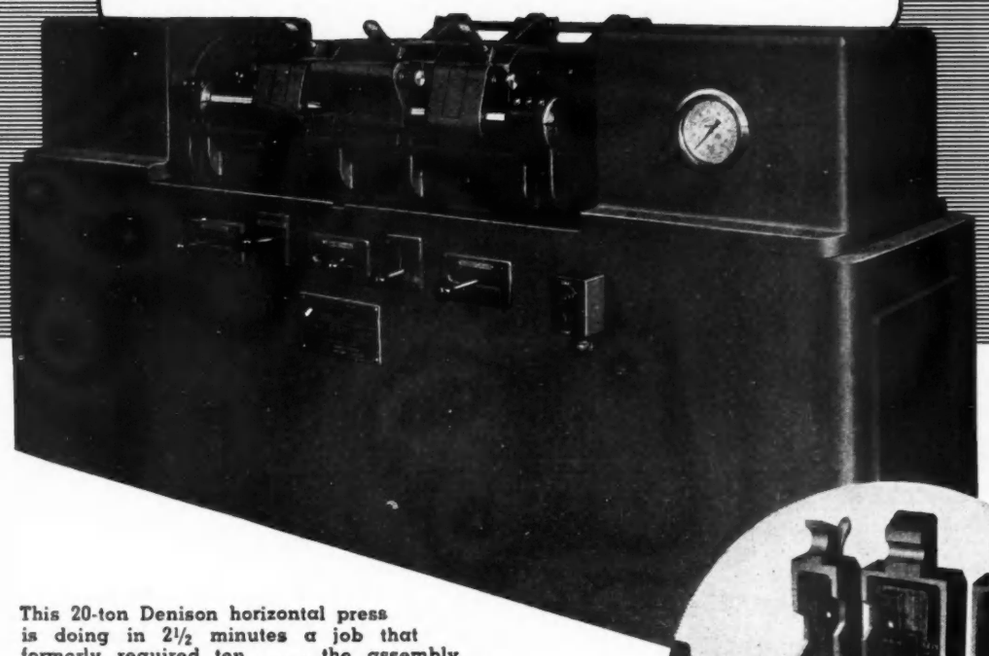
Joseph B. Eastman, director of the Office of Defense Transportation, and other nationally prominent government officials whose decisions affect the petroleum industry, will address a special evening session on Nov. 11.

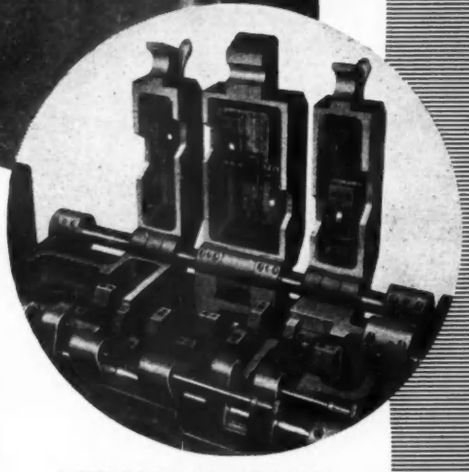
Acme

Experimental Tank

This huge gun housed in a well-armored tank is said to have proved its effectiveness during recent maneuvers of Army tank forces in a California desert.

10-MINUTE ASSEMBLY JOB CUT TO 2½ MINUTES





This 20-ton Denison horizontal press is doing in 2½ minutes a job that formerly required ten . . . the assembly and disassembly of airplane engine crankshafts.

War-rushed plants all over the country are getting help like this from Denison HydrOILics. And this application is only one example of the wide flexibility and ever increasing range of oil hydraulics. In this case, it eliminates tedious, painstaking hand effort and saves valuable time and labor.

The crankshaft is locked in the fixture in three sections, with the center section held rigidly in place and the two end sections remaining movable. Operation of the selector valve directs the hydraulic fluid to either the right or left hand ram. Movement of the ram-operating lever moves the sliding section of the fixture, and assembles the splined external and internal parts of the shaft. The operator then shifts the selector valve, applying pressure to the opposite ram and repeating the operation on the other end of the crankshaft.

This is oil hydraulics at its best . . . speeding war production of critical parts. In almost every industry, Denison HydrOILics is stepping up efficiency, saving materials, eliminating operations, doing jobs faster and better at lower cost.

To find out where Denison HydrOILics can help you, call your Denison representative or write directly to the factory. The Denison Engineering Company, 1178 Dublin Road, Columbus, Ohio.

SPECIFICATIONS

Maximum Stroke, each cylinder	4"
Maximum lateral opening	25"
Size of machined bolster	22"x44"
Depth of throat from center of rams	7" ± .005
Cylinder diameter	6"
Ram diameter	3"
Floor space	28"x93"

Helpful Literature!

A 28-page catalog illustrating Denison standard and special HydrOILic presses and their applications to production problems. Catalog contains a special 12-page section of valuable engineering data and tables. Write for your copy today! On your business letterhead, please.

DENISON EQUIPMENT in APPLIED HydrOILics

Army Ordnance Dept. Establishes Tank-Automotive Center in Detroit

All Functions of Engineering, Procurement and Maintenance of Self-Propelled Equipment Combined in Motor City

When the new Tank-Automotive Center of the Ordnance Dept. was formally opened by Maj.-Gen. Levin H. Campbell, Jr., chief of ordnance, at Detroit, Oct. 19, it marked another step in the program of decentralization being carried out by the government and the War Dept. Everything related to tanks and automotive equipment has been taken out of Washington and transplanted to Detroit. This involved the moving of personnel numbering 700 civilian employes and 125 Army officers from the national capital to Detroit. Similarly, the Ordnance Dept. has transferred headquarters for its far-flung explosive plants to Chicago, supervision of the ammunition works is now in St. Louis and small arms ammunition activity is centered in Philadelphia.

Commenting on the shift of tank-automotive procurement and supply to Detroit, Gen. Campbell told the Economic Club of Detroit, "It was but natural that Detroit with its great automotive industry and its galaxy of leading automotive engineers, executives, artisans and workmen should be the focal point for the mammoth tank and automotive program of the Army.

"This war will never be won by concentrations of organizations on the banks of the Potomac," Gen. Campbell continued. "We of Ordnance must get closer to the people who are making things, and work with them on the scene. This is no war of remote control. We of Ordnance who produce and service our fighting vehicles and our automotive rolling equipment have moved into Detroit lock, stock and barrel to stay with you until victory is ours. This Ordnance Tank-Automotive Center is not a new organization in the sense that it is formed from scratch to operate on its own. As a matter of fact it is a slice out of my office in Washington which has been moved here to be closer to the scene of automotive production. . . . This center will combine all the functions and operations required to make our tanks, our self-propelled weapons, our trucks, our jeeps and all our Army rolling stock. Here we will decide on designs of new automotive weapons and modifications of old ones; here we will do the Ordnance automotive engineering in close cooperation with the men in the automotive factories; here we will operate the vast system of Ornance automotive supply and maintenance for our armies wherever located."

Gen. Campbell said that policy on tank-automotive procurement and service would be decided in Washington but that operations would be directed from Detroit. He asserted that the Ordnance Dept. had not asked for the Motor Transport Service, which was transferred from the Quartermaster Corps to the Ordnance Dept., Aug. 1.

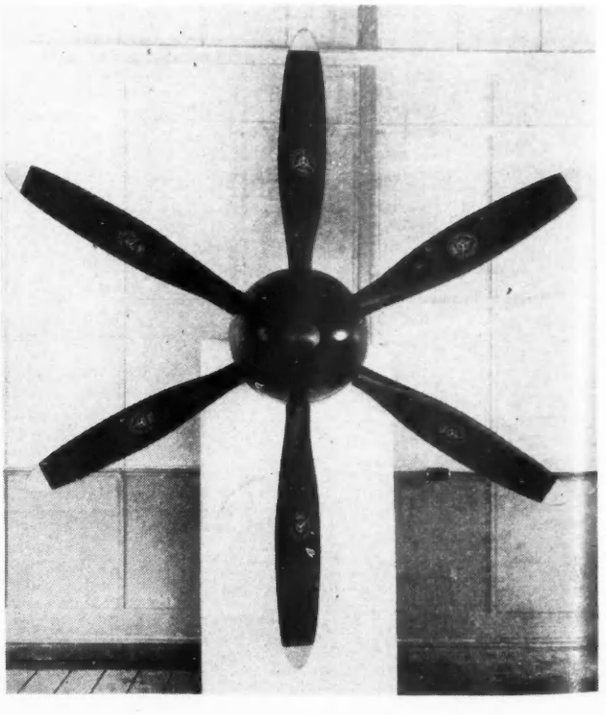
The Tank-Automotive Center will operate as one of five major divisions of the Ordnance Dept. The others are the Technical Division, Industrial Division, Field Service Division and Military Training Division. More than half the volume of the Army's Services of Supply is handled by the Ordnance Dept. and this now amounts to $50 billions per year. The 13 ordnance district offices around the country deal with the Tank-Automotive Center only on tank-automotive procurement and these district offices provide direct contact with the manufacturers of tank and automotive equipment. The various ordnance districts, of which the Detroit Ordnance District is the largest, help the manufacturer produce the tanks, inspect them to see that standards are met and arrange for payment.

Brig.-Gen. Alfred R. Glancy, a former General Motors vice-president and one-time general manager of the Pontiac Motor Division, is in charge of the Tank-Automotive Center as deputy chief of ordnance. He is assisted by Brig.-Gen. Donald Armstrong, former chief of the Chicago Ordnance District, as chief of the center and Brig.-Gen. John K. Christmas, formerly chief of the Tank Branch of the Industrial Division, as assistant chief. The four principal branches of the Tank-Automotive Center are the Development Branch, under Lieut.-Col. J. M. Colby; the Manufacturing Branch, directed by Col. M. E. Wilson; the Supply Branch, in charge of Col. P. G. Rutten, and the Maintenance Branch, under Col. S. E. Reimel.

As to Lead It's A Different Story

"Lead," says Erwin Vogelsang, Chief, Tin and Lead Branch, WPB, "is practically unique among metals today for it is the one important metal in which a shortage does not exist at the present time. However, it is impossible to predict what future demands may be, so control must be maintained to assure an adequate supply for any unforeseen requirements. Every effort must be made to keep mine production at peak levels. Our use of lead for all purposes has increased enormously—from 633,000 tons in 1936 to over a million tons in 1941. We are still using it in very large quantities."

Sustained domestic production of lead, plus imports substantially greater than normal, are supplying all war needs and building a Government stockpile. Recovery of secondary lead, a source which yielded 380,000 tons in 1941, must be expected to decrease as the war progresses. The 1942 supply from this source will be only about 90 per cent of 1941, the 1943 supply only about 75 per cent of 1941. Automobile batteries were the main contributor to the scrap pile but under present circumstances it is constantly declining. New metal must be provided to replace that which is not recovered from scrap in 1943. In normal years, 30 per cent of our lead goes into storage batteries.



Dual Rotation Propeller with Electric Pitch Control

The first six-bladed, dual rotation airplane propeller to be built about the principle of electric control of the pitch of its hollow steel blades. It is intended for use with engines of 2,000 hp. and is a product of the Curtiss - Wright Corp.

Information supplied by "Automotive & Aviation Industries"

The use of test tapping blocks is standard shop practice with a large aviation engine builder. Operators never use either an old or new tap without testing it first. The precaution saves many thousand dollars.

The blocks are made of aluminum or steel, depending on the metal being tapped. Formerly it was customary to drill holes in the blocks at random, and scrap them when all the holes had been tapped.

As the result of an employee's suggestion, this procedure has been changed. Now the blocks are laid out for drilling so that there will be just enough stock left to hold them together after drilling the biggest test holes. This conserves material by providing for the largest possible number of holes per block.

Also, the first holes drilled in new blocks are of the smallest tap hole size used in the plant. The block is used by the department having the smallest taps, then redrilled for the next larger taps, and passed on. The procedure is repeated until the block is useless.

The blocks are used from three to five times before they must be scrapped, and block life is correspondingly prolonged.

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MOLY

Revision of Armament Program May Alter Steel Requirements

With Curtailment of Plate Output, Cold Finished Sheet Production Is Being Stepped Up Under WPB Orders

By W. C. Hirsch

War materials producers in the automotive-arms group naturally look forward with lively interest to whatever concrete changes in steel distribution may result from the momentarily expected setting up of the new Materials Flow Plan. The proof of the pudding is the eating, and as several months are expected to be consumed in the necessary preparations, no worthwhile judgment is expected to be possible before next year. If the plan succeeds in establishing better distribution control, if the over-all steel tonnage can be more efficiently apportioned to the making of the various finished products, if, in short, the fulfillment of war contracts is facilitated, steel consumers no less so than producers will be gratified. In the light of what President Roosevelt said the other day regarding a revision of the armament program to make quality rather than quantity of output the criterion, the possibility of further adjustments, calling for a different outlook on the part of steel producers, can hardly be ignored. Obviously, if the strategists put an increasing amount of emphasis on the need of first class bombers or other aircraft, the picture of what the steel company executive has in his mind as to which descriptions of finished steel products will be most urgently needed in the prosecution of the war, is bound to change. The War Production Board recently ordered the output of steel plates, of which the mills can produce 1,250,000 tons a month, held down to 1,100,000 tons, so that more steel will be available for other descriptions of finished steel, the need of plates for shipbuilding being no longer quite so urgent. Such a change in policy, unavoidable as it undoubtedly was because of developments, that could not be foreseen, is far-reaching in its consequences and effect on steel production as a whole. Not so long ago, the country's rolling mills converted a large part of their sheet capacity to the production of plates. Now with the curtailment in plate output, they have another problem on their hands. Cold-finished sheet production is being stepped up under orders from the War Production Board, so as to absorb labor being made idle as the result of curtailment in tin mill operations. Some tin mill equipment, which is designed to roll relatively thin sheets, may come in for utilization in the rolling of sheets. The principal gain, however, will come from the increase in the supply of raw steel, formerly used in the manufacture of tin plate, current output of which has been reduced to approximately one-fourth of normal. The American Iron & Steel Institute points out that mill scrap yield has been greatly reduced because of the increased demand for heavy steel products, in the shaping of which much less scrap is obtained than when cold-rolled sheets or strip steel are rolled. This increases the dependence of steel mills on outside sources for their scrap needs.

The progressive tapering off in the monthly supply of domestic copper is giving the War Production Board and other war agencies much concern. Open-pit mines from which about half of the domestic copper supply is derived, have maintained their quotas, but the output of underground mines has been slipping. Whether it will be necessary to pay for more copper the 5-cent a pound premium over the 12-cent rate granted for certain tonnages to high-cost producers is a problem now under consideration. Ceiling prices on copper to-day are about one-half of the price fixed in 1917, the so-called Government price being increased to 26 cents in the following World War I year.

Jeffers Names Rubber Consultants

A staff of six technical consultants on the nation's rubber program has been appointed by Rubber Director William M. Jeffers. They will serve under Col. Bradley Dewey, deputy director who has undertaken the technical aspects of the program.

The consultants include E. B. Babcock, chief chemist of the Firestone Tire & Rubber Co., Akron, an expert on Latin American rubber and guayule; L. D. Tompkins, vice president of the U. S. Rubber Co., who helped develop that company's far eastern plantations; Dr. E. R. Gilliland, professor of chemical engineering at Massachusetts Institute of Technology, Cambridge, Mass., a specialist on petroleum technology and synthetics; W. L. Campbell, vice president of the American Machine Defense Corp.; Morehead Patterson, president of the American Machine Foundry Co., and Ray P. Dinsmore, development manager for Goodyear Tire & Rubber Co., Akron, a research expert on crude and synthetic rubber.

More Thiokol Predicted

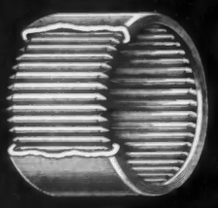
William Britton, a chemist with the Dow Chemical Co., recently predicted at Bay City, Mich., that with the conversion of idle chemical plants and with Dow planning a new plant, production of Thiokol probably will total 60,000 tons in 1943, while 1944 output may reach 120,000 tons. Dow recently was given authority by the Defense Plant Corp. to spend in excess of $1,500,000 for machinery and equipment to be installed in a Michigan plant.

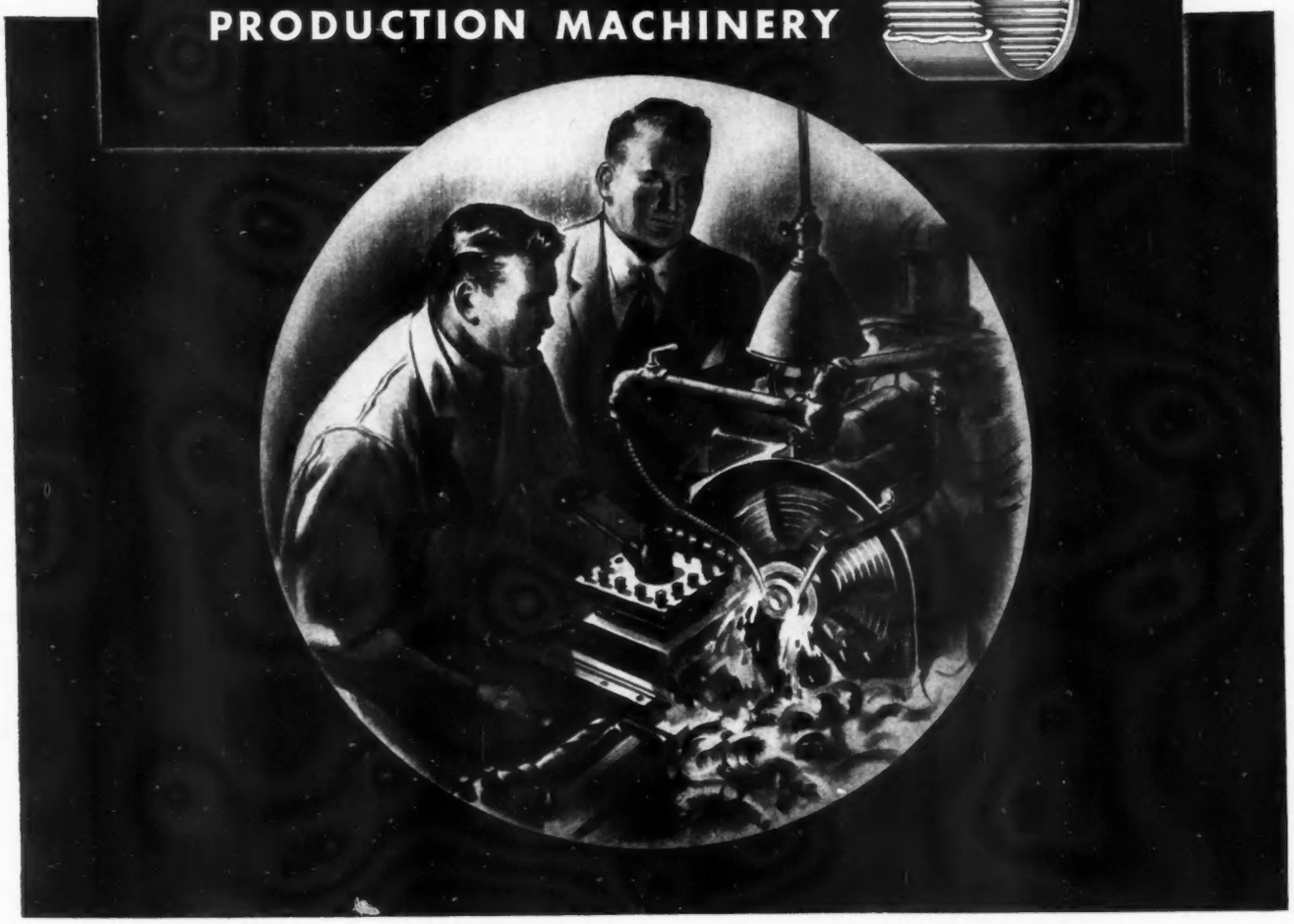
New Aircraft Plants

Northrop Aircraft Inc., Hawthorne, Cal., has signed a contract with DPC to build and equip a plant in California costing more than $2,500,000. Fairchild Aviation Corp., Jamaica, N. Y., has been authorized to spend more than $350,000 to equip a New York plant.

Light reconnaissance and armored battle units turned out by the Canadian plant of General Motors. Equipped with Bren guns, they are characterized by speed and maneuverability.

...AND IN AMERICA'S WAR PRODUCTION MACHINERY





IN OTHER YEARS, production machinery had a comparatively easy time of it — even for this country, birthplace of mass production. But nowadays, plant equipment is subjected to extremely heavy intermittent loads, hums faster than in any peacetime period, without letup.

To keep the nation's war production moving at top speed around the clock, tougher materials had to be developed... many machine parts redesigned. But the only "change" industry required of the Torrington Needle Bearing was its conversion to war production. In the heavy-duty machinery of America-at-war, this unique bearing is again proving its adaptability — in applications where its definite advantages mean more than ever.

Its low coefficient of friction is assuring smooth performance... its high capacity and efficient lubrication are reducing the need for replacement or maintenance attention, enabling management—through steadier production —to turn out greater quantities of war equipment. From the standpoint of the machine builder, the Needle Bearing's small size, saving space and critical materials, and its remarkable ease of installation, cutting assembly time, mean faster delivery of production machinery to wartime assembly lines.

And so it is easy to see why the Needle Bearing was one of the first machine parts to "change over" and why, too —with the war production program increasing in volume and intensity— no further change has been necessary.

***IN ADAPTING** the advantages of the Needle Bearing, the experience of Torrington's Engineering Department is at your disposal. Information on capacities and sizes is given in Catalog No. 107. We invite you to write today.*

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TORRINGTON NEEDLE BEARING

Every feature fills a wartime need

"Know-How" May Serve to Offset Industry's Labor Shortage

WLB and Union Leaders State Views Regarding Denial of Wage Increases to Ford Workers

Detroit, Flint, Pontiac and Lansing, all large automotive centers, are among 66 areas in the country in which labor shortages exist and which have been certified by the War Manpower Commission to be avoided if possible in placing war procurement contracts. However, these Michigan cities probably will continue to receive some additional contracts despite the labor stringency because in the WPB directive making this effective, it is provided that "in general, contracts involving the more difficult war production problems should be placed with concerns best able, by reason of emergency, managerial and physical resource, to handle them." The know-how of the automotive industry will qualify it for some of these contracts. Other automotive manufacturing sites designated as short of labor are Muskegon and Saginaw-Bay City, Mich.; Buffalo, Akron Cleveland, Springfield Dayton and Warren, Ohio; Evansville, Ind., and Clintonville, Wis. Aircraft production centers with manpower shortages include Hartford, Conn.; Indianapolis, Wichita, Kan., San Diego, Calif., and Seattle.

In a War Labor Board decision of Oct. 17 denying a $1 per day wage increase asked by the UAW-CIO of the Ford Motor Co. in negotiations for a renewal of the contract which expired June 1, the WLB set forth the policy that any further wage increases in the automobile industry at the present time would be contrary to the interests of the war effort. Wayne L. Morse, public representative on the board, wrote:

Considering the wages of the entire industry, the opinion held that "the conclusion is inescapable" that present wages "constitute a fair and equitable stabilization wage pattern for the time being." It said that Ford wages permitted a good standard of living and were recognized as the highest in the industry. This was emphasized by the fact that Ford wages increased 28 per cent between Jan. 1, 1941, and May, 1942, compared to the 15 per cent standard set by the Little Steel formula. General Motors wages rose 13.4 per cent in the same period. GM workers were granted a 5-cent per hour raise and Chrysler Corp. employes received a 4-cent per hour raise in recent WLB decisions.

Ford workers with five years or more seniority were granted an increase in their vacation allowance from one to two weeks' pay. However, union demands for a 10-cent per hour night shift bonus and equalization of rates in all Ford plants throughout the country were denied by the WLB. The union estimated the bonus allowance will amount to $9,600,000. Workers also were allowed four hours' call-in pay instead of two hours.

Commenting on the WLB ruling opposing further wage increases in the automotive industry, R. J. Thomas, president of the UAW-CIO said, "I can see no justification in a theory under which a war worker in one plant should receive lower wages than another worker doing the same job in another plant in the same community." Richard T. Leonard, director of the union's Ford division, said the ruling in the Ford case illustrated the inadequacy of the so-called Little Steel formula, which falsely assumes that workers were receiving wages on Jan. 1, 1941, that provided them with a decent standard of living.

Although 115,000 Ford workers failed to get wage raises, 1197 Ford employes received awards totaling $924,000 as the result of an arbitration decision growing out of unfair labor charges filed against the company by the NLRB. Rev. Albert H. Poetker, S. J., executive dean of the University of Detroit, made the award as arbitrator. The men had been dismissed between 1937 and 1941 for union activity. A total of $1,626,515 was paid to 1344 Ford employes last year in similar cases which were decided by direct negotiation. The other cases went to the arbitrator.

Efforts of 23,000 Chrysler Corp. workers to obtain $1,800,000 in unemployment compensation benefits for the time they were idle during the 54-day Chrysler strike in 1939 finally were terminated Oct. 12 when the U. S. Supreme Court refused to review a decision of the Michigan Supreme Court which was adverse to the employes' claims. Litigation in the case had been in progress for more than 2½ years and the workers had received two favorable decisions before it went to the highest state court.

WLB cases involving tool and die workers in the Detroit area were decided by a decision of Oct. 10 which granted raises of 10 cents per hour to 10,000 employes in the "captive" shops of GM, Ford and Chrysler but denied any increases to 5000 workers in 193 job shops of the Automotive Tool & Die Association. The UAW-CIO had asked for increases of 40 to 45 cents per hour for "captive" shop workers and 15 cents per hour for job shop employes. To halt labor pirating and an upward spiral of rates that has created serious inequalities in the industry, the WLB placed a ceiling of $1.75 per hour for any employes hired hereafter in the job shops. In "captive" shops a minimum of $1.40 per hour and a maximum of $1.60 per hour were established. The present average wage is $1.63 per hour in job shops and $1.43 in "captive" shops. The UAW-CIO immediately announced a drive in the "captive" shops to bring wages up to the $1.60 per hour maximum.

Another WLB panel recommendation of Oct. 22 denied a blanket minimum of $1.50 per hour to maintenance workers in GM, Ford and Chrysler plants. However, the panel did recommend a six-cent per hour boost for machinists, machine repairmen, millwrights and skilled electricians, who compose about 35 per cent of the 31,000 maintenance employees involved. It also authorized raising the maximum rate 5 cents an hour at Ford and 10 cents an hour at Chrysler and GM but did not make raises mandatory. The UAW-CIO had contended that plant maintenance men are paid 25 to 50 cents per hour less than similar skilled tradesmen in the construction industry.

Business in Brief

Written by the Guaranty Trust Co., New York, Exclusively for AUTOMOTIVE AND AVIATION INDUSTRIES

Steadily maintained rates of general business activity prevail. The seasonally adjusted index of *The New York Times* for the week ended Oct. 10 rose four fractional points to 130.5 per cent of the estimated normal, as compared with 127.0 a year ago. The index of *The Journal of Commerce*, without seasonal adjustment, for the same period advanced to 130.7 per cent of the 1927-29 average, a new war-time peak, from 129.4 for the preceding week.

Department store sales during the week ended Oct. 17, as reported by the Federal Reserve Board, were 16 per cent above comparable levels last year; and for the four weeks then ended sales averaged 11 per cent more than the corresponding amount a year earlier.

Railway freight loadings during the week ended Oct. 17 totaled 900,767 cars, 1.0 per cent less than the number for the week before and 2.4 per cent below that for the comparable period last year.

Electric power output increased more than seasonally in the same period and was 12.2 per cent greater than a year ago, as against a similar excess of 10.3 per cent a week earlier.

Crude oil production during the week ended Oct. 17 averaged 3,902,250 barrels daily, 45,500 barrels above the figure for the preceding week but 163,970 barrels less than the average output recommended by the Office of the Petroleum Coördinator.

Average daily production of bituminous coal during the week ended Oct. 10 was 1,986,000 tons, as compared with 1,883,000 tons in the week before and 1,858,000 tons a year ago.

Professor Fisher's index of wholesale commodity prices for the week ended Oct. 16 stood for the third consecutive weekly period at 108.2 per cent of the 1926 average, as against 98.3 a year ago.

Member bank reserves increased $1,000,000 during the week ended Oct. 21, but estimated excess reserves dropped $360,000,000 to a total of $2,350,000,000. Business loans of reporting members rose $23,000,000 in the preceding week but stood $215,000,000 below the total a year earlier.

"This Aeroprop does everything but talk!"

"IT'S LIGHT—Not an ounce of useless weight about it. That means the Aeroprop delivers maximum horsepower and fight-power per pound."

"IT'S STRONG—And you can bet that strength pays off in safety and longer fighting service."

"IT'S SIMPLIFIED—Unit-construction puts automatic pitch control, plus the power for pitch changes, right in the compact propeller assembly itself."

Many a pilot on many a front could tell a better story of the Aeroprop than we can.

They've pulled the trigger on the deadly gun that pokes its barrel through the Aeroprop's hollow hub.

They're flying every day, and sometimes every night, so they praise the strength and durability of this steel propeller.

Too, they've been in spots where the pounds saved by the Aeroprop's simplified, unit-construction have meant the inches-to-spare or the instants-to-spare that count so much in high-speed fighting.

They know what it means to fly behind a propeller that is always "on speed," a propeller that responds almost instantly to every flight maneuver—climbing, cruising, diving, *fighting!*

They also know that quality goes into an Aeroprop. The best materials. The best American craftsmanship. Performance that is based on the latest achievements of propeller engineering, research and design. The day and night team-work of propeller engineers, production workers, and technicians of the United States Government, all working to produce more and more Aeroprops for America's mounting might in the air.

"Everything but talk!" The Aeroprop will never need to talk where ACTION speaks louder than words—where there are pilots who have flown with it, fought with it, and conquered with it.

AEROPROP

AEROPRODUCTS DIVISION **GENERAL MOTORS** CORPORATION

GM ARMS FOR VICTORY

Tire Chain Production Cut by WPB

Production of tire chains for commercial vehicles was ordered discontinued by the War Production Board, on and after Oct. 31, 1942. The same order (L-201) limits the number of chains to be made for passenger automobiles.

The order limits the production of tire chains, chain parts, and emergency unit parts for passenger automobiles, during the twelve month period following Oct. 31, 1942, to not more than 16 per cent of the total quantity of metal used in the production of all tire chains, all chain parts and all emergency unit chains during the twelve month period following April 1, 1941. Only 25 per cent of the material so authorized is to be used in the production of tire chains.

Chain parts and emergency unit chains for commercial vehicles may be made in quantities not exceeding 24 per cent of the total amount of metal used in the total production of all tire chains, all chain parts and all emergency unit chains during the 12 month period following April 1, 1941.

A simplification provision in the order reduces the number of types of chains that may be produced to three, and the number of sizes to four. It also prohibits the use of any metal other than low carbon steel in the manufacture of chains or chain parts. This restriction, WPB said, will save small quantities of molybdenum, copper, zinc and tin.

Seamobile to Be Built By U. S. Shipbuilding Corp.

E. R. Stettinius, Jr., Lend-Lease Administrator, announced that the contract for the construction of the first full-scale Seamobile has been let by Cargoes, Incorporated, to U. S. Shipbuilding Corporation, Yonkers, N. Y.

As stated in the Sixth Lend-Lease Report, Cargoes, Incorporated, is the instrumentality through which the Office of Lend-Lease Administration is carrying on the development of the Seamobile, or re-designed Sea Otter. The experimental Seamobile will be about the same size as the Sea Otter II. The most important change is that the propellers will be moved to the stern. The contract calls for completion of the vessel within 90 days after delivery of the structural steel for the hull.

Good News for Some Violators

Attorney General Francis Biddle has advised the Secretaries of War and Navy that manufacturers who mistakenly employ ineligible aliens on aeronautical or confidential war contracts are not liable to prosecution if the employment was given in good faith.

MEN . . . . . .

Elbert E. Husted has been elected president of Tite-Flex Metal Hose Co. He joined the Tite-Flex organization in 1924, becoming sales manager in 1930. He was elected a vice president in 1936 and was made general manager in 1938. Mr. Husted succeeds as president, C. W. Fletcher the founder of the company who died three months ago.

Members of the Industrial Air-Cooled Engine industry advisory committee recently appointed by WPB are **Earl Ginn**, vice president of Continental Motors Corp., Muskegon, Mich.; **R. B. Harvey**, sales manager of Novo Engine Co., Lansing, Mich.; **Edward V. Oehler**, vice president of Briggs & Stratton Corp., Milwaukee; **J. R. Merriam**, Waukesha Motor Co., Waukesha, Wis.; **Charles D. Allan**, Kiekhaefer Corp., Cedarburg, Wis.; **E. A. Jacobsen**, Jacobsen Mfg. Co., Racine, Wis.; **E. A. Longenecker**, Lauson Division of the Hart Carter Co., New Holstein, Wis.; **D. W. Onan**, D. W. Onan & Sons, Minneapolis; **P. A. Tanner**, Johnson Motors Division of Outboard Marine & Mfg. Co., Waukegan, Wis., and **H. A. Todd**, Wisconsin Motors Corp., Milwaukee.

Elmer Bimberg, formerly chief engineer, has been appointed plant manager of the Zenith Carburetor Division of Bendix Aviation Corp., Detroit, succeeding J. T. Black, who has resigned. **Harold W. Snow**, formerly assistant personnel director of the Bundy Tubing Co., Detroit, has been named personnel manager for Zenith.

R. K. White, formerly associated with the sales and advertising departments of Pontiac and Chevrolet in an executive capacity and with Campbell-Ewald Co., Inc., Detroit advertising agency, has been appointed chief of the General Salvage Section, Conservation Division, of WPB. He had been serving as chief of the Tin Salvage Unit.

A. J. Baker, formerly administrator of the War Production Drive at B. F. Goodrich Co., has been appointed manager of factory personnel at Akron, Ohio.

A. E. Goosen, general purchasing agent, and **Sam Montgomery**, supervisor of nonproductive materials, have been honored by Oldsmobile for 25 years' service with that division of GM.

A. E. Shelton, formerly works manager of the Stinson Division of Vultee Aircraft, Inc., has been promoted to the position of division manager.

Thomas H. Corpe has been appointed general sales manager of the Elastic Stop Nut Corp. He was formerly assistant general sales manager of the Lockheed Aircraft Corp.

Metal & Thermit Corp. has announced the following personnel changes: **Charles D. Young** has been made sales manager of the welding division. **Merritt L. Smith** has been appointed assistant sales manager. He is also advertising manager.

Appointment of **Leonard W. Reeves** as vice-president and general manager of the manufacturing division was announced by the Toledo Steel Products Co.

Fred W. Climer, director of personnel at the Goodyear Tire & Rubber Co. has joined the War Production Board in Washington.

The Ramsey Accessories Mfg. Corp. has announced the appointment of **T. Randall DuBois** as plant manager.

A. O. Thalacker has been appointed general manager of the Detroit Rex Products Co. He is also secretary of the company.

Herbert E. Smith has been elected president of United States Rubber Co. and also chairman of the executive committee and a member of the finance committee.

D. L. Immel has been promoted to assistant plant superintendent at the Copperweld Steel Co.'s Warren, Ohio plant.

C. N. Kirkpatrick, vice-president and general manager has been appointed president of the Landis Machine Co. He will continue his duties as general manager.

A. E. Hitchner, former manager of the Los Angeles office of Westinghouse Electric & Mfg. Co. has been appointed assistant to the manager of the company's industry sales depts. with headquarters at the Pittsburgh works.

Carl J. Kennedy has been made salesmanager, assistant secretary and assistant treasurer of the Hydraulic Machinery, Inc. He was formerly salesmanager of the McAleer Co.

Raymond J. Fitness has been appointed operating manager in charge of manufacturing at Willys-Overland Motors. He was formerly manager of the automotive department of the organization's manufacturing division.

The Board of Directors of Wilkening Mfg. Co. has elected **Warren K. Lee** vice-president, with headquarters in Detroit.

Adel Precision Products Corp. announces the appointment of **Harold P. Wade** as general manager.

Briggs Mfg. Co. announces the following personnel changes: **E. E. Lundberg**, vice-president in charge of engineering, has been appointed a director of the company, succeeding the late Howard Bonbright; **F. W. Hofmann**, formerly assistant factory manager of all Briggs plants, has been made vice-president.

George L. Randall has been appointed public relations manager of Wickwire Spencer Steel Co. He continues also as advertising manager.

Tom O. Duggan, general manager of the service division of Thompson Products, Inc., Cleveland, has been elected a vice-president of the company.

World's Largest Spray Booth?

Huge enclosure 150 x 200 ft., 35 ft. high, recently installed in southwest bomber plant. Glass air filters arranged in 912 cells are shown at left. One of the eight exhaust units is at the right. Note man beside it and judge its size.

saved, but-

HOW MUCH MORE?

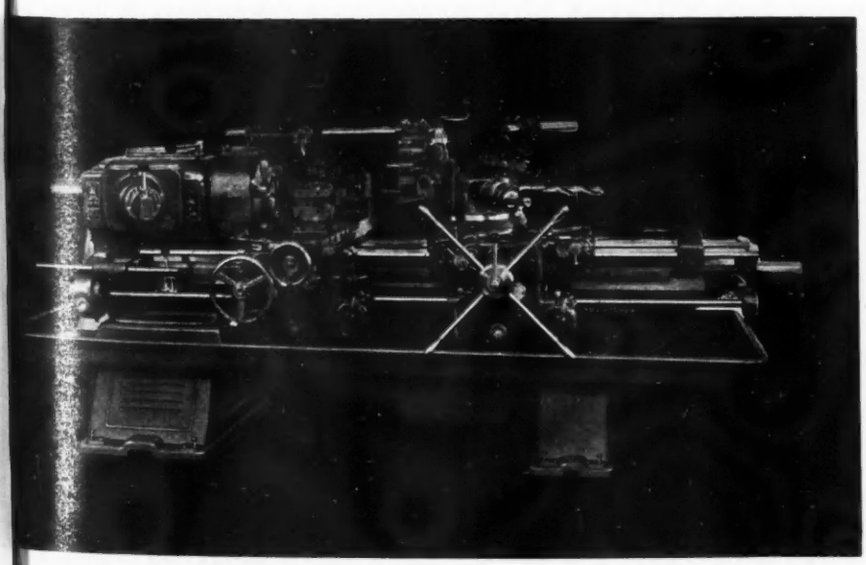
THE flat turret lathes of '95 developed by James Hartness are made no longer, but new Jones & Lamson Turret Lathes — faster, more precise, more rigid and easier to operate than ever — are paying for themselves *over and over* out of savings.

No longer does a skeptical world demand such money-saving equipment from its makers on trial. The big question today is not how much can be saved by Jones & Lamson equipment, *but how much more* when equipment and production plans are co-ordinated by Jones & Lamson methods.

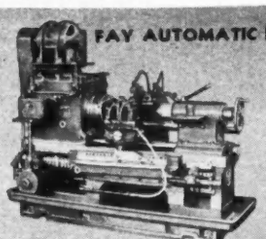
That is why progressive manufacturers habitually put their production problems up to Jones & Lamson engineers. That is why such plants, planned and equipped to meet today's emergency, will be in strategic position to face the harsh competition that is bound to follow this upheaval.

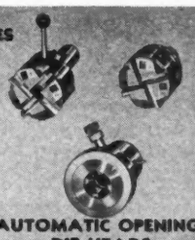
Why not see what Jones & Lamson engineering and Jones & Lamson machines can do to put your plant in such a strategic position? Inquiries from large concerns or small receive thorough, detailed study here, and illustrated catalogs are available.

MACHINE COMPANY - *Springfield, Vermont, U. S. A.*



7A Jones & Lamson Saddle Type Universal Turret Lathe with standard chucking equipment.





J&L

PROFIT PRODUCING
MACHINE TOOLS

PUBLICATIONS

A new handbook of instructions regarding the installation and maintenance of **Simmonds-Corsey flexible aircraft controls** has been issued by Simmonds Accessories, Inc. The booklet gives specific instructions for the best service and longest use of the product and also includes a 2-page drawing of a typical control layout.*

Detroit Rex Products Co. has issued a new booklet describing and illustrating **Detrex Metal Parts Washers.** Several pages are devoted to blueprint type of assembly drawings covering the construction of washers using both belt and monorail conveyors.* Another booklet by Detroit Rex Products is a 24-page 2-color catalog on **Detrex Solvent Degreasing equipment.** Amongst important features in the booklet are numerous illustrations of various types of degreasers, and data on solvents.*

Smith-Johnson Corp. has a new bulletin describing the construction and uses of **Senacon Air Motors,** which are finding wide application for the provision of auxiliary reciprocating fractional hp for drill presses, milling machines, etc.*

Two new folders by Turner Uni-Drive Co. are (1) **The Turner Uni-Drive,** for machine tools describing and illustrating its 4-speed selective sliding gear transmission and (2) **The Turner Gear Box Drive** designed especially for Brown & Sharpe automatic screw machines.*

Turco Procedure for Aircraft Engine Overhaul is the title of a new booklet describing equipment and procedure for a new, improved fast method of degreasing and decarbonizing aircraft and other engine parts for overhaul. The booklet is released by Turco Products, Inc.*

A Guide to Better Bearing Lubrication is the title of a new 32-page booklet by SKF Industries, Inc. It contains designs, formulae and graphs explaining the technical text.*

General Electric Co. has issued two new booklets 1) a **motor fitness manual** which discusses how to get the most service out of old and new motors, switching motors from one job to another and equipping old machines with new motors and 2) a new, illustrated bulletin on **arc-welding accessories.***

Hanna Engineering Works has issued a new catalog, number 232, on its **squeeze riveters.** The catalog is well illustrated and gives a general idea as to the many styles of riveters and their applications.*

Keep 'Em Working is the title of a new book by Caterpillar Tractor Co. designed to aid owners of its products in getting the most out of their machines.*

Catalog No. 13, South Bend Lathe Works, contains full information on **South Bend 13 inch Precision Lathes,** and the attachments, accessories and tools for use with the lathes. A section of the catalog contains the construction features of the quick change gear box, carriage, spindle bearings, motor drive, etc.*

Porter-Cable Machine Co. has just issued a new booklet giving information on its new method of **wet abrasive belt surfacing.** It describes, illustrates and gives specifications for the Porter-Cable line of belt surfacing machines.*

Westinghouse Electric & Mfg. Co. has issued a new 6-page bulletin describing the use of **Precipitron** in war industry production. It is titled Air Clean As A Whistle with Westinghouse Precipitron.*

The Acromark Corp. has a new 8-page color brochure illustrating and describing more than 65 modern **marking tools and machines** for accomplishing Ordnance and industrial marking.*

Bound Brook Oil-Less Bearing Co. has issued a new bulletin completely describing its new material, known as **Powdiron,** with special emphasis placed on the desirability of the new material as a logical substitute for restricted materials.*

A new booklet, **Rubber Conservation for Users of Industrial Rubber Belting,** by The B. F. Goodrich Co., illustrates step-by-step procedure for making repairs on conveyor belts by the use of portable electric vulcanizers. Interesting examples of savings already made and valuable rubber conserved are given.*

E. W. Bliss Co. has issued a new booklet on the **Bliss, Toledo and Consolidated inclinable presses,** showing many new details in construction. A description accompanies each model illustrated together with pages of complete dimensions, specifications of standard presses and special features and attachments.*

Bulletin No. 301, Progressive Welder Co., describes and illustrates the **Temp-A-Trol Forge Welder.***

Cooley Electric Mfg. Corp. has issued a new bulletin on its **Electric Furnaces** for industrial and laboratory uses. It includes specifications, descriptions and illustrations of its various types of furnaces.*

An **instruction chart,** covering all points in the assembling and closing of General All-Bound Boxes, has been prepared by General Box Co. It is complete with photographs and drawings, showing the various steps in assembly and the tools used.*

A new booklet has been issued by Norton Co. for users of **abrasive wheels.** It is well illustrated and contains a Question and Answer section. The booklet's title is How To Use Truing and Dressing Tools for Better Grinding.*

An attractive folder, by Gisholt Machine Co., describes its 45 minute sound and color motion picture on Turret Lathes — Their Operation and Use. Information is included regarding procedure for securing the film for use by manufacturers, organization, etc.*

23 Ways to Conserve The Life of Your Multiple V-Belt Drives is the title of a booklet prepared by the Engineering Research Bureau of the Multiple V-Drive Assoc. It is written in a simple, easy-to-understand manner as an aid to the rubber conservation movement.*

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* Obtainable through editorial department, AUTOMOTIVE *and* AVIATION INDUSTRIES. Address: Chestnut and 56th Sts., Philadelphia. Please give date of issue in which literature was listed.

Waukesha Expands

Waukesha Motor Company, Waukesha, Wis., has broken ground for additional factory space to house work for the navy department, J. E. DeLong, president of the firm, has announced. The addition will be in the form of engine test cells supplementing present test room facilities of the company. The building project is part of an expansion program recently announced with the purchase of a plant on Elizabeth street to be taken over on Nov. 1. The firm is embarking on the production of aircraft engines for the Navy.

CALENDAR

Conventions and Meetings

American Petroleum Inst., Annual Mtg., Chicago .....Nov. 9-13
Natl. Industrial Chemical Conf. & Exposition, Chicago .....Nov. 17-22
Natl. Chemical Exposition, Chicago, Nov. 24-29
Amer. Society of Mechanical Engrs., New York City, Annual Mtg. Nov. 30-Dec. 4
Highway Research Board, St. Louis, Mo. .....Dec. 2-4
SAE Air-Cargo Engineering Mtg., Chicago .....Dec. 8-9
SAE War Production-Engineering Mtg., Detroit .....Jan. 11-15

BOOKS . . .

INTERNAL COMBUSTION ENGINES, *by J. A. Polson. Second Edition. Published by John Wiley & Sons, New York.*

This work, which first appeared about ten years ago, has been largely rewritten and has had considerable new material added. It is intended as a textbook for classroom instruction, and the various chapters are followed by a series of problems for the student to work out. The entire field of internal combustion engines is covered, both theoretically and practically, including the Diesel engine. Illustrations and descriptions of engines are largely confined to the larger stationary type, which are not subject to such frequent changes as automobile engines. The first 140 pages of the book are devoted to what may be regarded as a theoretical treatment of the subject. Then follow chapters on Gas Engines, Automobile Engines, Carburetors, Ignition Systems, Valves and Valve Timing, Airplane Engines, Diesel Engine Performance, Turbulence, Scavenging, and Supercharging, Precombustion Chambers in Diesel Engines, Diesel Fuel Injection Systems, Cooling of Engines, and Gas Turbines.

THE NATIONAL PAINT DICTIONARY, *by Jeffrey R. Stewart. Published by the Stewart Research Laboratory, Washington, D. C.*

This publication contains a large amount of information, in dictionary form, of use to men connected with the paint and lacquer industry and with painting and finishing departments of other industrial concerns. It gives definitions or brief descriptions of the many materials, both organic and inorganic, used in the paint industry, processes and equipment used in the industry, trade names, etc. This is a second edition and includes a Supplement of general physical and chemical data. The book is essentially a work of reference, and as such should prove useful to those connected in a technical capacity with firms producing paints, varnishes, lacquers, etc., as well as to the managers and technicians of the finishing departments of large industrial concerns in other fields.

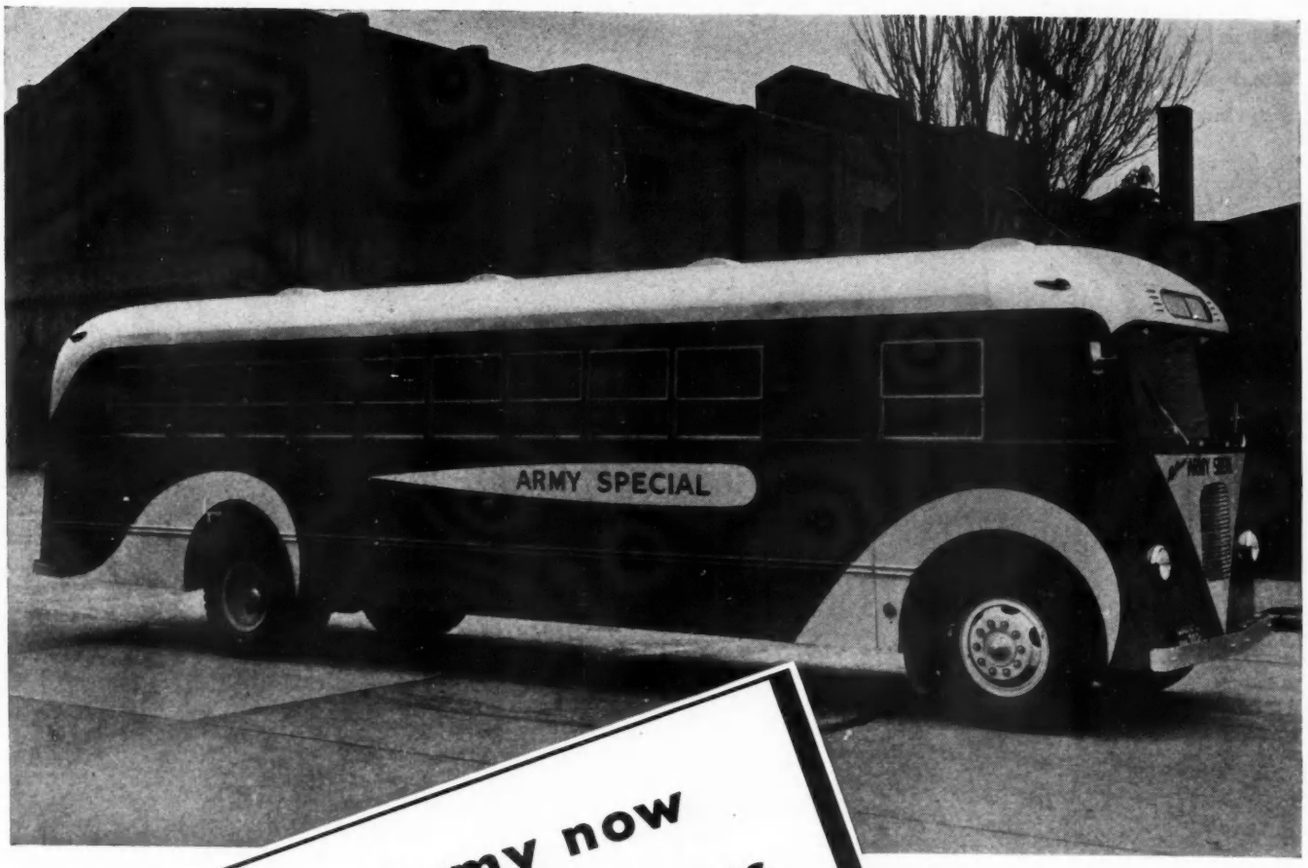
JANE'S ALL THE WORLD'S AIRCRAFT, *compiled and edited by Leonard Bridgman. Published by the Macmillan Co., New York.*

This new edition, covering the history of the aviation industry to the end of 1941, is replete with information on the design of hundreds of aircraft and aircraft engines. Section A contains a review of the air forces of the world; Section B, completely rewritten and revised, covers the history of civil aviation; Section C, the aircraft section, remains as before the largest section of the book; and Section D, describing aircraft engines, contains information on many types of engines produced in the last few years.

This book can be recommended to any one who is interested in the history of the industry and the description of modern equipment. The products of the United States, Great Britain, Germany, Japan, Italy, and many other countries are comprehensively covered.

Bullard Workers Buy Plane

Employes of the Bullard Co., Bridgeport, Conn., raised enough money in two days to purchase a Republic P-47 fighter plane for the Army Air Forces. Presentation of the plane was made at Bridgeport, with acceptance by Maj. Gen. James E. Chaney, commanding general of the First Air Force.



It's in the Army now ...on SKF Bearings

Built by
KENWORTH MOTOR TRUCK CORP.

Helping this bus to convey soldiers over mountainous roads is no picnic for any kind of bearings—not even SKF's. But SKF's take it because they're designed to carry heavy loads without needing constant attention in maintaining their extremely close tolerances indefinitely . . . to give top performance throughout a long life. All of which boils down to the outstanding fact that it's like any other machine that's SKF-equipped: It has bearing performance . . . *plus!*

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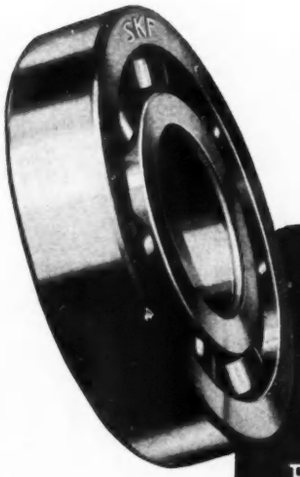
SKF INDUSTRIES, INC., Front St. & Erie Ave., PHILA., PA.



SKF
BALL AND ROLLER BEARINGS

Chemical Show to Be Held at Chicago

Combined with the National Chemical Exposition, which is to be held at the Hotel Sherman, Chicago, Nov. 24 to 29, will be a series of technical sessions devoted to timely topics of chemical production, engineering and research. An outstanding feature of the technical sessions will be the first symposium on research work with the electron microscope. More than 40 such microscopes are now in use in this country, and it is estimated that they are being used by about 200 persons, all of whom have been invited to contribute to the symposium. The symposium will be held on Friday morning, Nov. 27, and will be preceded on Thursday evening, Nov. 26, by a talk by W. K. Zworykin, associate director of the RCA Manufacturing Company's research laboratories, on "The Electron Microscope in Chemical Research." One of these microscopes will be shown in operation, and there also will be exhibited about a hundred photographic prints obtained with electron microscopes.

Wartime interest in the exposition will be further emphasized by special exhibits revealing what has been accomplished in providing substitutes and alternates for critical materials.

WROT FITTINGS BY NIBCO
NIBCO
EXTRUDED FROM A
SINGLE STRAIGHT TUBE
AN
Engineering Miracle!
FORMED in one step from a straight tube . . . NIBCO WROT tees, crosses, ells, and return bends are marvels of engineering development. Every one is perfectly formed . . . absolutely "round and square" . . . uniform in thickness and strength. The same engineering genius which made this possible is at work today developing new products and time-saving processes for war. NIBCO valves and fittings will have their share in winning it. But in the new day that is to come . . . you'll need us and we'll need you. Remember NIBCO service . . . from blueprint to packaged product . . . made right . . . delivered on time.
NORTHERN INDIANA BRASS CO.
ELKHART, INDIANA
VALVES AND FITTINGS SINCE 1904

Out of the Army, Back to the Mines

Robert P. Patterson, Under Secretary of War, has issued the following statement: American war production is being held back for lack of copper, zinc, molybdenum, tungsten, and other critical metals. To relieve this situation, the War Department has authorized the release, from active military service, of 4000 experienced miners. These men are being furloughed, so that they may resume the mining of ore vitally needed to arm our fighting forces.

Rayon Plants Conversion Ordered

Rubber Czar Jeffers has approved an order for the conversion of rayon plants to provide 50,000,000 pounds of rayon annually for use in tire production. Regarding outlook for synthetic rubber production, he stated that after the middle of next year we should have sufficient capacity to make quite an improvement in the tire situation and that by 1944 there should be sufficient capacity to take care of all essential civilian automobile travel.

Storage Battery Prices Regulated

OPA has announced that prices of electric storage batteries sold by manufacturers and wholesalers will be subjected to formal price regulation on Nov. 7. For storage batteries for replacement use in passenger cars and trucks, the price is to be one cent per pound of lead content above seller's price on Oct. 1, 1941. In no instance may the ceiling exceed the highest price charged in March, 1942.

Studebaker Expands

Studebaker Corp. has been granted authorization for an increase of more than $6,500,000 by the Defense Plant Corp. for additional facilities in Indiana and Illinois, where Studebaker is making aircraft engines. This brings the company's total DPC commitments to more than $70,000,000. Chrysler Corp. has been awarded a contract for more than $4,000,000 to equip an unnamed Michigan plant.

George Kissell

George Kissell, 61, formerly head of the old Kissel Motor Car Co. Hartford Wis., and president of Kissell Industries, Inc., died unexpectedly at his home Oct. 15 following a short illness after returning from a business trip to the East on a navy contract.

BETHLEHEM
STEEL

Tank Production

(*Continued from page* 46)

Dept. would use the council's help.

Besides such automotive tank producers as Chrysler, Fisher Body, Ford, Cadillac and International Harvester, a number of other automotive companies, especially in the parts field, are engaged in the machining and the heat treating of armor plate. A group of 33 industrial plants in Michigan, Ohio, Pennsylvania, Massachusetts, Wisconsin and West Virginia has been integrated into a working unit under the direction of the Standard Steel Spring Co., Corapolis, Pa. This group was formed last February by Standard Steel Spring, which set up an Armor Plate Division at Detroit.

Most of the automotive companies in this group formerly were engaged in manufacturing springs and bumpers. They include the General Spring Bumper Division of Houdaille-Hershey Corp. and the Midland Steel Products Co., both of Detroit; the W. B. Jarvis Co., the McInerney Spring & Wire Co. and the Michigan Bumper Corp., all of Grand Rapids; the Gerity-Adrian Mfg. Co., Adrian, Mich.; Buckeye Bumper Division of Electric Auto-Lite Co., Springfield, Ohio; Burton Auto Spring Corp. and Maremont, Auto Products Co., Chicago; Mather Spring Co., Toledo; and the Youngstown Buick Co., Youngstown, Ohio. Other factories from the stove, steel, furnace, enamel products, railroad equipment and hardware industries make up the balance of the 33 companies involved.

Great Lakes Steel Corp., Ecorse, Mich., ships rolled steel plates to each company. That company heat treats and straightens the plates, machines and cuts them to specifications and ships to the tank manufacturer which it serves. In addition to Fisher Body, Cadillac and International Harvester, other tank makers supplied with armor plate by the group are American Locomotive Co., Lima Locomotive Co., Pacific Car & Foundry Co., Pressed Steel Car Co. and Massey-Harris Co. Two makers of combat vehicles, Yellow Truck & Coach Mfg. Co. and Caterpillar Tractor Co., also are supplied with armor plate.

Another division of Electric Auto-Lite Co. besides the Buckeye Bumper Division, which is machining armor plate, is engaged in the tank program. This is the new Toledo Tank Depot, operated by Electric Auto-Lite, which recently was awarded the Army-Navy "E." Radio and electrical equipment are installed in the tanks at this depot after they come from the manufacturer. Twenty-two plants of Electric Auto-Lite are engaged in war production.

Increasing emphasis on aircraft production at the expense of other war products may have some effect on the tank procurement program through use of alloy steels. Airplanes have been put at the top of the list by President Roosevelt in line with the recent announcement that the Army Air Forces would require 2,200,000 men as part of the 7,500,000-man army in 1943.

In the past two years the automotive industry has played an increasingly larger role in the aircraft procurement program. Between Oct. 25, 1940, when the old Automotive Committee for Air Defense was formed at the instigation of Lieut.-Gen. William S. Knudsen, and Oct. 25, 1942, automotive companies have made and delivered more than $1 billion in aircraft equipment such as airframes, airplane engines, propellers and other parts. Current output of these components is at a rate exceeding $4½ million per day. Approximately 45 per cent of the automotive industry's armament orders are for aircraft on a dollar volume basis.

In a recent speech before the Economic Club of Detroit, Gen. Knudsen predicted that 50 per cent or more of the heavy bomber program would be made from parts produced in Detroit and other Michigan plants.

General Motors war deliveries for 1942 went over the $1 billion mark in September totalling $1,203,849,889 for nine months compared with $406,149,273 in all of 1941. September deliveries of $212,851,360 were 3 per cent greater than August or at an annual rate of better than $2.5 billion.

TOTAL STRENGTH..
Total strength is a quality found only in laboratory controlled Drop Forgings. Cost departments are constantly searching for lower production expense, and that is a laudable thing to do. But first costs do not solve any production problem. You have to see it through, to final machining and actual, unfailing use. Here's the reason why Atlas Drop Forgings (Laboratory Controlled) are more in demand than ever before.
ATLAS
DROP FORGINGS
ATLAS DROP FORGE CO., LANSING, MICH.

Thorough Sand Conditioning

is essential to successful operation

Bartlett-Snow Conditioning Equipment gives the sand new life under mechanically controlled conditions. It provides a more uniform and more thorough mix than can possibly be secured in daily production with hose and shovel methods—and the work is done usually overhead, resulting in great savings of floor space.

Complete facilities are available including pug mills or paddle mixers, that churn and mix old sand, new sand, and binder—compact mullers that give the sand, continuously, the milling coating action required for silica sand poured at high temperatures—batch mullers—elevators in two styles—storage and tempering bins—weigh hoppers—feeders—elevating belts with automatic water sprays when a minimum of reworking is required.

No two systems are exactly alike. Each installation must be engineered for the individual plant—and the size, type and arrangement of equipment varied to meet the tonnage per hour desired and the floor space, head room and other conditions that vary with each case.

Our recently issued 40-page Foundry Bulletin No. 90 illustrates many different Sand Conditioning Plants and other Bartlett-Snow Foundry Equipments. Copies are available on request.

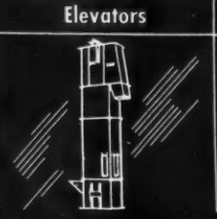
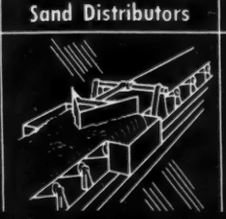
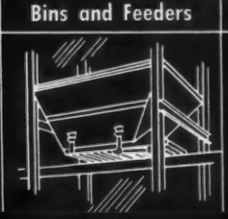
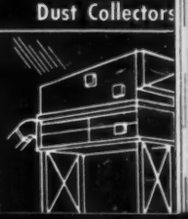
100% War Bond Buyers
Average Payroll Deduction—14%
H. S. Hersey
PRESIDENT

THE C. O. BARTLETT & SNOW COMPANY
6201 Harvard Avenue Cleveland, Ohio
Engineering and Sales Representatives in the Principal Cities

BARTLETT-SNOW

ENGINEERS AND FABRICATORS FOR THE FOUNDRY INDUSTRY

Complete Sand, Mold and Castings Handling Equipment for any requirement, including

Shakeouts	Elevators	Aerators	Sand Distributors	Bins and Feeders	Apron Conveyors	Dust Collectors
						

New Products

(*Continued from page* 45)

A NEW Speedriver kit has been placed on the market by Aircraft Tools, Inc., Los Angeles, Cal. The kit features a wrench type tip holder and includes two sizes of Phillips screwdriver tips, two sizes of Reed Print screwdriver tips, two sizes of standard screwdriver tips, two socket wrench tips and a spiral burring tip.

An adapter is furnished so that these tips may be used with a power driving unit. The tips fit into the wrench without special holding clips, and can be quickly changed from one to the other for various types of work.

Braid Insulated Sterling Cable

A new series of Auto-Lite Sterling low tension aircraft electrical cables, known as "B" Braid Synthetic, has been announced by the Wire Division of The Electric Auto-Lite Co., Port Huron, Mich. This cable has been approved under the Joint Army-Navy Specification AN-JC-48 in sizes ranging from 22 ga. to 00 ga.

The insulating compound is a synthetic, protected by special "B" type cotton braid, with a newly-developed lacquer of unusual abrasion resistance. Insulation, braid and lacquer are all flame resistant, reducing fire hazard.

Aircraft Tools, Inc., Speedriver.

Low moisture absorption avoids increase in weight under service conditions, as well as corresponding reduction in insulating efficiency.

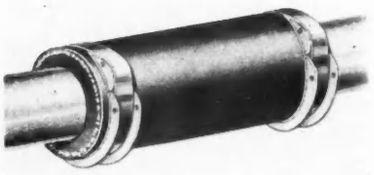
Ranger Two-Way Radio

A new two-way radio is announced by the Electronic Specialty Co., Los Angeles, Cal., which firm manufactures the Ranger line of aircraft radio equipment. Consisting of three separate units, the equipment includes a Model 503 power supply which operates from the airplane's twelve volt storage battery, a Model 110 reciever that has both

Ranger Two-Way Aircraft Radio Equipment.

the 195-410 kc. band and a "spot" frequency pre-tuned to 3105 kc., and a Model 206 10.5 watt output transmitter which operates on 3105 and 6210 kc. The units are connected by flexible cables, permitting considerable flexibility in installation. In addition to the "spot" frequency, the receiver is equipped with a two-way interphone circuit for communication between pilot and observer.

(*Turn to page* 70, *please*)



A new type aircraft and industrial hose clamp being made by Huntington Precision Products, Huntington, West Va. It employs a wrap-around, self-locking arrangement and may be installed by hand, without tools.

National Emergency Alternate Steels

Designation	Chemical Composition (b)				
	C	Mn	Mo	Ni	Cr
NE8024	0.22-0.28	1.00-1.30	0.10-0.20	....	....
NE8124	0.22-0.28	1.30-1.60	0.25-0.35	....	....
NE8233	0.30-0.36	1.30-1.60	0.10-0.20	....	....
NE8245	0.42-0.49	1.30-1.60	0.10-0.20	....	....
NE8339	0.35-0.42	1.30-1.60	0.20-0.30		
NE8442	0.38-0.45				
NE8447	0.43-				
NE8547	0.43-				
NE8620	0.18-				
NE8630	0.27-				

Will the Machinability of NE Steels prove to be a Tough Problem?

THE answer will be "Yes" or "No"—depending upon the skill used in handling the change-over.

Changes may be required in tools and tooling; changes in speeds and feeds, *and in cutting fluids.* When this last factor is considered

Stuart Oil Engineering Service

is equipped and ready to help you apply the *Right Cutting Fluid* to "cranky" steels.

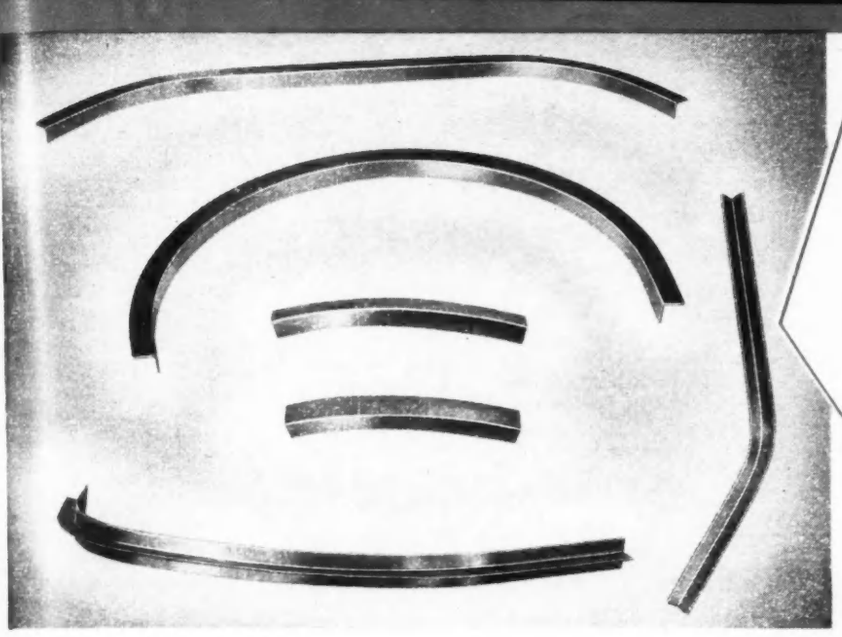
Stuart's Thred Kut
HEAVY DUTY CUTTING OIL
Recommended by America's leading machine tool builders

Stuart's SOLVOL
LIQUID CUTTING COMPOUND
For carbide tools and where an "aquamix" solution is recommended

Stuart's CODOL
LIQUID GRINDING COMPOUND
Meets every test for the ideal Modern Grinding Compound

Stuart's "SUPER-KOOL"
AMERICA'S FIRST TRANSPARENT SULPHURIZED CUTTING AND DRAWING OIL

For All Cutting Fluid Problems
D. A. STUART OIL CO.
Chicago, U.S.A. • LIMITED • Est. 1865
Warehouses in All Principal Metal Working Centers



Change PLANE & RADIUS as many times as wanted

SIMPLE TO OPERATE

The Southern No. 12 Die-Flow Metal Former attachment is a self-contained unit that is used on the Southern No. 10 Metal Forming Machine. Two controls vary the speed of die travel and the amount of pressure exerted on the metal. One operator and a helper can do the work of scores of men otherwise required to hand-form the parts.

EXTREMELY FLEXIBLE

Whether it is a part requiring as small as a 1⅞" radius on a single change in radius, or a part that requires reverse curves in series—whether the part is only a few inches long, or 30 feet in length—whether there is no change in plane, or a dozen changes . . . the Southern No. 12 attachment does the work with equal speed and efficiency.

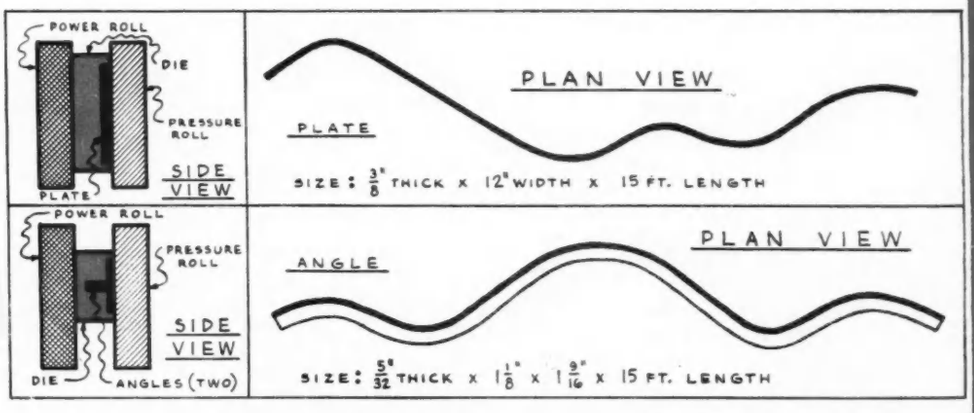
DIES QUICKLY CHANGED

Installation of dies and former blocks requires no special skill—is quickly done . . . so that short runs of special parts are just as practical as long runs of production parts. In some aircraft plants Southern Machines operate 24-hours per day on one extrusion design—in other plants the dies may be changed every few hours.

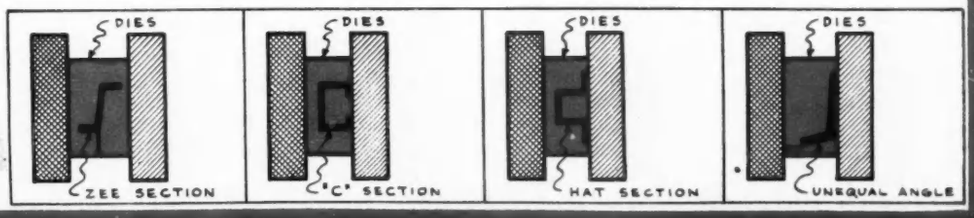
RUGGEDLY BUILT

All Southern Machines are ruggedly built to withstand continuous operation under severest production conditions. Frames are welded steel; air cylinders, hydraulic acccssories, electric motors and variable speed gear drives are designed especially for their particular functions. Maintenance and servicing requirements have been held to a minimum, with easily accessible grease and lubrication points.

We offer the services of engineering, die and tool manufacturing—for use on Southern Machines.



At right—is shown typical die and former block designs, and typical plan views of formed flat and angle stocks. Location of the rollers which exert pressure on the metal, from the air cylinder, is also shown.



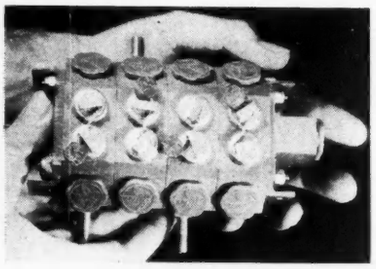
At right—different types of dies for Z, C, Hat and angle extrusions are shown. Location of the rollers is also indicated. As many changes in radius and plane as may be desired can be handled with these simple, full length Die-Flow dies.

SOUTHERN ENGINEERING CO., INC.

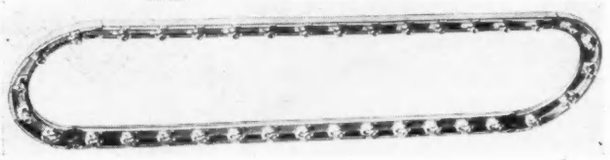
816 West 5th Street Los Angeles, California

New Type Hydraulic Valve

A new development in aircraft hydraulic equipment, the "Stacking Midget" valve, is announced by the Adel Precision Products Corp., Burbank, Cal. Designed to permit installation of multiple hydraulic controls in limited space, such as cockpit control panels, the quadruple unit stacking valve measures 5 31/32 inches by 3 3/16 inches by 2 7/16 inches and weighs 2.9 lb. Individual valve assemblies may be replaced or repaired by breaking only the two cylinder lines affected. Fitting as a single body, any number of units may be clamped together by means of "thru" bolts and end plates which also serve as flanges, and symmetrical design permits turning end for end to meet desired shaft arrangements. Over-travel is prevented by an integral stop located on the cam shaft. The valves and assemblies are completely interchangeable.



The Adel "Stacking Midget" valve



An inspection port curved channel made by the Boots Aircraft Nut Corporation, New Canaan, Conn. Channel and Circular Channel in factory fabricated shapes are now obtainable wherever sufficient quantities are required to justify the jigs, etc., needed in their production.

WE CAN'T DO A THING 'TIL THE CARPENTERS BUILD THOSE WORK-BENCHES ...PRODUCTION IS SURE HELD UP!
YOU SHOULD HAVE ORDERED "HALLOWELL" READY BUILT STANDARDIZED WORK-BENCHES

This will never happen to you, if you choose.. HALLOWELL SHOP EQUIPMENT

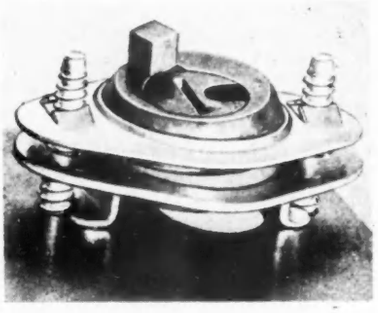
You can standardize on "Hallowell" Work-Benches—choose from 1367 combinations. Spare yourself all the trouble of building your own benches. "Hallowell" Work-Benches are delivered promptly, set up quickly and stand firm and rigid without costly bolting to floor. Five leg heights and widths for your selection. Tops of smooth laminated wood, Masonite and, if advantageous, of steel. Get our Catalog for complete details.

FIG. 928
Drawer is extra
Pat'd & Pats. Pend'g

STANDARD PRESSED STEEL CO.
JENKINTOWN, PENNA., BOX 611 · BRANCHES: BOSTON · DETROIT · INDIANAPOLIS · CHICAGO · ST. LOUIS · SAN FRANCISCO

Tinnerman 'Speed-Align' Guide Block

A new "Speed-Align" adjustable fairlead guide block, that is universal for any angle of cable, is now being produced by Tinnerman Products Inc., Cleveland, Ohio. This new guide block is comprised of a three piece macerated phenolic plastic guide that is housed between an aluminum base and a special spring steel speed nut. The plastic guide is universal for any angle of cable and the plastic parts may be replaced without unthreading the cable.



Tinnerman "Speed-Align" adjustable fairlead guide block

Where a 29/32 inch hole is practical in structure, the aluminum base of the fairlead is not used, as the plastic guide is housed directly in the 29/32 inch hole.

Schwarze 'Uni-Pact' Plant Signals

To meet changing conditions in manufacturing plants, the Schwarze Electric Co., Adrian, Mich., have developed a system of interchangeable signals,

One Virtue IN COMMON

Whether your choice be Bulldog, Setter, Spaniel, Airedale, Dane, Terrier or St. Bernard, yours shares one of his best qualities with the rest. You can depend on him to do at your bidding that for which he was bred and trained.

Remember that, also, as characteristic of **PUSH-PULL CONTROLS**. They may be designed of different dimensions and for different purposes—for the remote control mechanisms such as brakes, gear shifts and blades of tractor-operated scrapers, shovels and cranes. They provide vital, remote control for much American fighting equipment.

All of these **PUSH-PULL CONTROLS** provide positive control. Operation is easy because the moving part operates in an hermetically sealed bath of lubricant. They are all rattle-free. But, above all, each can be depended upon to do the job for which it was designed and built.

Remember that. Glad to work with you to develop **PUSH-PULL CONTROLS** to fit your planned peace-time production.

PUSH-PULL AUTOMOTIVE CONTROLS

AUTOMOTIVE AND AIRCRAFT DIVISION

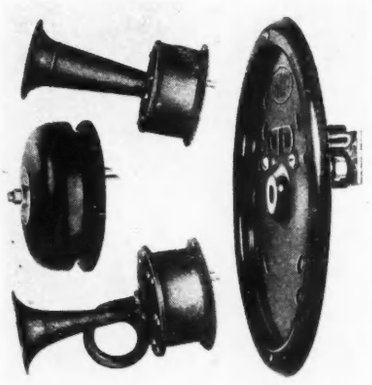
6-235 General Motors Building, Detroit · 695 Bryant Street, San Francisco

AMERICAN CHAIN & CABLE COMPANY, Inc.

BRIDGEPORT · CONNECTICUT

which may be plugged into uniform adapter plates, avoiding the necessity of disturbing wiring when changing units.

This system, which Schwarze calls "Uni-Pact," makes it possible, for instance, to replace bells with larger or smaller ones or to replace them with horns or trumpets, simply by removing one signal from the adapter plate and replacing it with another signal.



"Uni-Pact" Signals and adapter plate of the Schwarze Electric Co.

BUY

DEFENSE BONDS AND STAMPS

. . . AND LONGER LASTING AETNA BALL BEARINGS

☆ Remember the wiser you buy the more you help to conserve labor and materials that are indispensable to a nation at war—to *VICTORY!*

Long-lived, dependable AETNA PRODUCTS mean less frequent replacements, increased production and extended machine life. You save for yourself, for your country.

AETNA BALL BEARING MFG. CO.

4600 Schubert Ave., Chicago

Thrust Ball Bearings (Standard and Special) . . . Angular Contact Ball Bearings . . . Roller Bearings (Special) . . . Ball Retainers . . . Hardened and Ground Washers

"Bubblfil"

A NEW material, known as "Bubblfil," has been developed by E. I. du Pont de Nemours & Co., Wilmington, Del. It consists of strings of air filled cellophane bubbles and the makers believe that it will be found suitable for some applications where scarce materials, such as kapok or sponge rubber, have formerly been used. The bubbles do not break when squeezed, and laboratory tests, equivalent to altitudes of upwards of 50,000 feet, have shown that they do not burst at the low atmospheric pressures of high altitudes.

The resiliency of the cellophane bubbles, a property derived from the elasticity of the trapped air, has encouraged the du Pont Company to study their suitability as a shock absorbing material. The "Bubblfil" has been formed by means of an adhesive material, into mats and cushions. These might be used for padding in airplanes and tanks.

Chemically, "Bubblfil" is the same materially as cellophane or rayon, namely, regenerated cellulose made by the viscose process. The syrupy viscose material is extruded through a single spinneret hole, relatively large in size. A small amount of air is injected into it at regular intervals just as the filament is coagulated by the acid bath in which it is being spun. The size and spacing of the bubbles may be arranged according to choice.

Ryan Manifolds for Radial Engines

(*Continued from page* 29)

modeling department is building patterns. Completion of the patterns by the modeling shop permits the dies to be cast in the foundry. To facilitate the work done in the modeling shop, a foundry is located immediately adjacent to it, and is under the general supervision of the modeling-department head. The modeling shop foundry also has a complete drop hammer unit, so that it can set up the dies it makes, clear them for metal thickness to be stamped, and actually stamp one or several parts before releasing them for production work.

Having arrived at what was then considered to be a fair arrangement on the basis of tool planning, it was necessary to revise the plant layout in order to coordinate these efforts. Formerly, parts for manifolds were routed through the factory in the same manner as airplane parts. Such parts as flanges and analyser bosses and such operations as tube cutting and machining formerly were routed to the machine shop. Doublers, hangers and trimming operations were routed to the sheet metal department, and tacking to the spot-welding department. This very obviously, was not a satisfactory method for volume production. It was found

WELLS SAWS get things done!

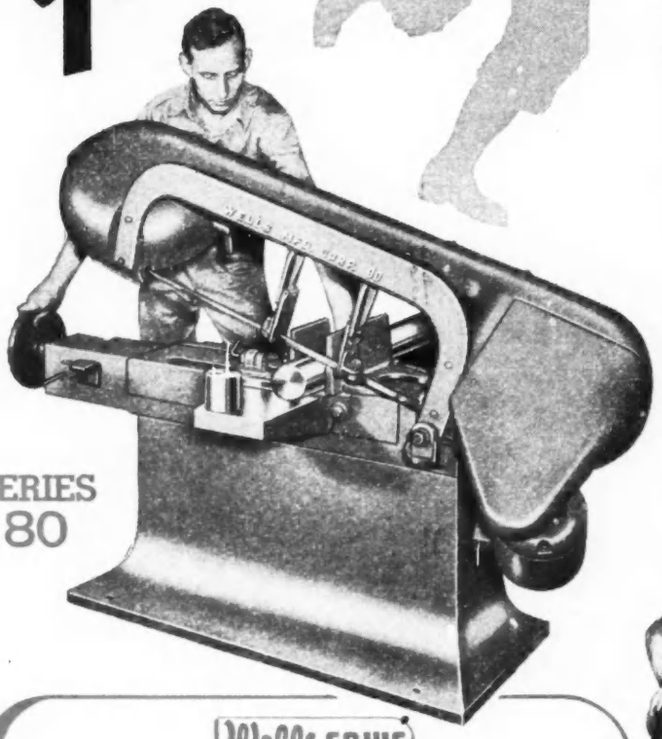
When it comes to fast, accurate metal cutting

BIG jobs or little jobs—tool steel or aluminum—production or maintenance work—whatever your metal cutting requirements, a Wells Saw will help you get things done.

With the new, more capable V-12 you can apply the principle of continuous cutting to the bigger jobs—up to 13 in. by 16 in. rectangular or 13 in. diameter round. The model 80 saw, too, is an improved unit—redesigned for ruggedness and ability.

Put a Wells Saw to work in your plant now—you can get one quickly from your mill supply dealer or write direct.

Wells Has Established Leadership



SERIES 80

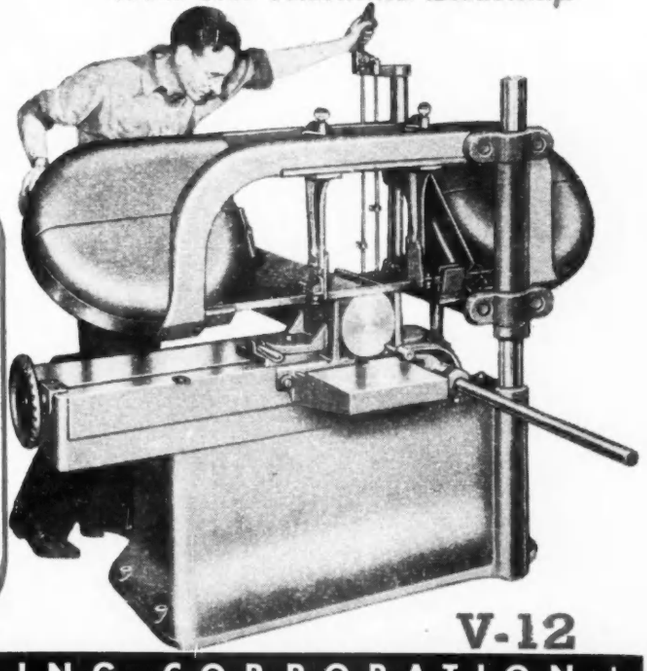
Wells SAWS
THE SIGN OF SERVICE

SPECIFICATIONS
SERIES 80 METAL SAW

Capacity: Rectangle	8" x 16"
(spec. bowed guides)	5" x 24"
Rounds	8" dia.
Speeds: ft. per min.	60, 90, 130
Motor	Specifications optional

V-12 METAL SAW

Capacity: Rectangle	13" x 16"
Round	13" dia.
Speeds: ft. per min.	50, 90, 150
Guides	Adjustable
Feed	Hydraulic-Controlled
Vise	New quick acting type
Motor	Specifications optional



V-12

WELLS MANUFACTURING CORPORATION

Wells METAL CUTTING BAND SAWS

101 JEFFERSON STREET • THREE RIVERS, MICHIGAN

necessary to make a thorough and complete study of manufacturing methods, as they existed at the time. This examination was conducted by means of a flow process chart. The chart was made up similar to a case history in which a complete record of the part from its inception in the form of an engineering drawing, to its completion as a finished part, was kept in chronological order. This chart divided all operations into the following classifications: Operations, transportations, storages and inspections.

The loss of time, loss of parts, waste of energy and loss of production on some of the items revealed by this study were very surprising. In addition, serious errors in production were brought to light, even though they had existed for long periods. The total distance which the parts traveled was shown at the bottom of the chart, and every movement of the part was very carefully recorded.

For convenience in visualizing the flow of a part, rough diagrams of the manufacturing space are made. These diagrams emphasize the existence of bottlenecks and back tracking. While these phenomena do appear in the summary of the flow process chart as excessive distances traveled, the existence of many parallel lines on the flow diagram bring them to light. It proved unnecessary to make a flow process sheet for each piece or product. One or two models usually account for the greatest volume of production. These are then used as a guide and charted in detail, allowing the other models to conform to the general plan.

The process chart is a useful layout tool to develop conventional template layouts of the manufacturing space available. On this manufacturing space layout, the various machines employed are moved into position and jigs and fixtures relocated to intercept the "flow" as indicated on the flow process sheet. In this way the welding equipment, machine equipment and assembly fixtures are placed in their most convenient and natural locations.

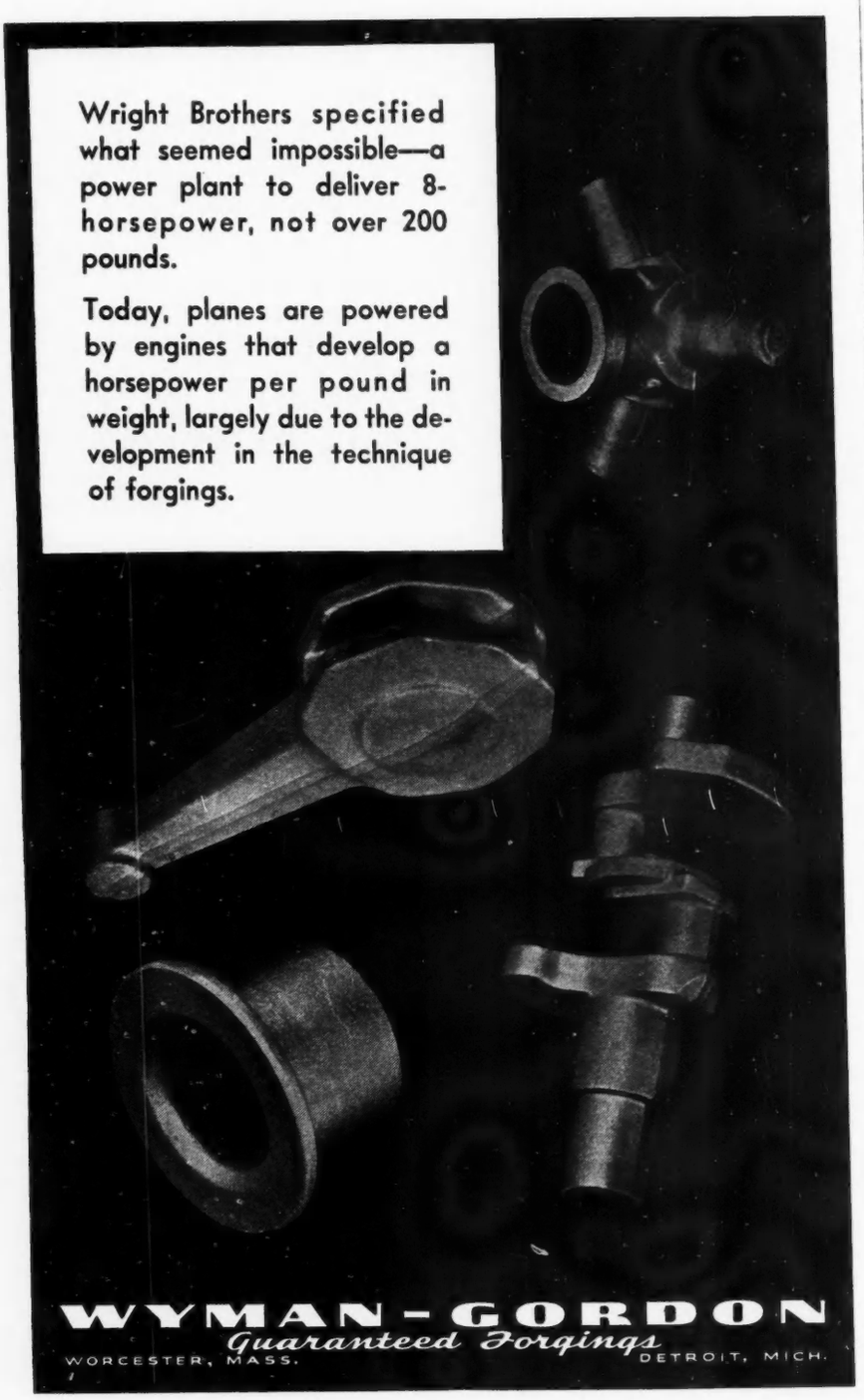
Having thus set up a production system, the problem of production control came up. It was found that methods established for airplane manufacturing were not at all suitable for controlling the "flow" in the manifold section. The system adopted is a modified "block system" successfully used in the garment industry. The manifold is considered as a suit of clothes, in the sense that there is a general balance of parts and processes in the former, as compared to a balance of pieces of cloth and methods of joining them in the latter. Minor changes in the process at various points will call for only slight changes in the balance of time requirements at each point to permit a manifold to flow through the cutting, fabrication, assembly and final inspection. Production flow is controlled through "control points" established in a natural way along the lines of production.

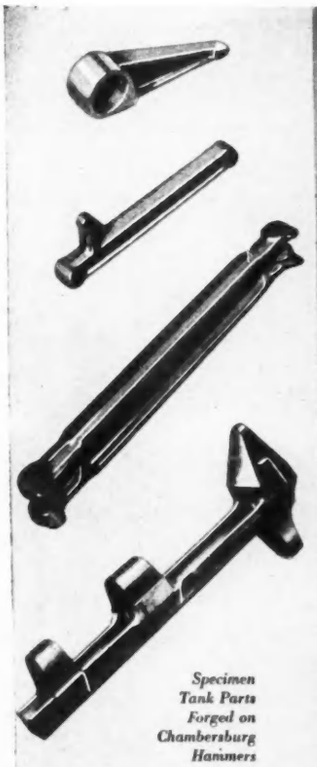
Parts are stamped in large quantities, pickled and sent to permanent storage. From here on all work is controlled by work progress cards. These cards allow the work to progress through the system in predetermined lots. When the card is filled, it is signed off by the leadman of the group, who receives another card from the dispatch station together with any additional parts required.

Longer intervals are allowed between certain control points subject to interruptions, or for delays in transportation. The parts just completed are passed along to the next station with a new control card and any additional parts required for that operation.

As each control point receives a work progress card, together with a block or lot or parts, it is entered on a graph in the dispatch station. Only one card is issued ahead of the schedule, which prevents any operation from getting too far ahead and permits a much better distribution of man power.

Savings of 26,000 tons of metal including steel and copper are said to be resulting from changes in the construction of U. S. Army camp facilities sufficient for the accommodation of 100,000.


Wright Brothers specified what seemed impossible—a power plant to deliver 8-horsepower, not over 200 pounds.
Today, planes are powered by engines that develop a horsepower per pound in weight, largely due to the development in the technique of forgings.
WYMAN-GORDON
Guaranteed Forgings
WORCESTER, MASS.
DETROIT, MICH.



Specimen Tank Parts Forged on Chambersburg Hammers

Airplane Engine Parts Forged on Chambersburg Hammers

FORGINGS COME FIRST

★

Forgings are vitally essential to the war effort because airplanes, tanks, ships and guns must be built to "withstand the unpredictable" . . . for which specification there is nothing to equal the strength and durability of the drop forging. ★ Before the cutting and grinding machine tools bring these parts to their final microscopic perfection, they are first forged to close limits, by tremendous impact between steel dies, in great drop hammers, such as those bearing the time-honored name of CHAMBERSBURG. Metal is saved, time is saved . . . and Victory brought closer . . . by the speed, power and accuracy of Chambersburg Hammers.

CHAMBERSBURG ENGINEERING CO., CHAMBERSBURG, PA.

THE CECOSTAMP
Airplane and other sheet metal parts of high strength alloys are formed quickly and without distortion on the Chambersburg CECOSTAMP.

The Cecostamp is an impact stamping machine of exceedingly flexible control, designed by Chambersburg Engineering Company specifically for the aviation industry.

CHAMBERSBURG

HAMMERS • CECOSTAMPS • PRESSES

National Metal Congress

(*Continued from page 35*)

Combustion, Mahr Mfg. Co., Despatch Oven Co., Lindberg Engineering Co., and The Ohio Crankshaft Co., with its Tocco hardening process.

On the other end of the temperature scale, Deepfreeze Div., Motor Products Corp., and Kold-Hold demonstrated equipment for the treatment of metals at sub-zero temperatures for the aging of steel, for expansion fits in assembly operations, for airplane rivet storage, etc. Deepfreeze is currently developing techniques for producing temperatures as low as minus 120 deg. F.

In the metals group were familiar names—International Nickel Co., P. R. Mallory, Aluminum Co. of America, S. K. Wellman, Dow Chemical Co., Handy & Harman, Climax Molybdenum, Rustless Iron & Steel, and others.

Pangborn and American Foundry Equipment Co., demonstrated their lines of shot-blasting and sand-blasting machinery for cleaning forgings and castings.

Welding equipment group included such names as Sciaky Bros., one of the chief factors in the airplane field, Progressive Welder, Resistance Welders Mfrs. Assn., Swift, Thomson-Gibb, Marquette, and others.

The abrasives divisions of Norton and Carborundum had displays of the latest developments in this field, with Norton distributing an interesting manual on trouble-shooting on grinding problems.

S. C. Johnson & Son demonstrated a new line of rust-inhibiting wax coatings, highly resistant to corrosion and rusting of metals. A new line of bracket-mounted motorized drives for machine tools, with infinite variable speed control was shown by Reeves.

Trico Products Corp., showed its Micro-Check, a visual indicator comparator gage, designed for rapid inspection of close tolerance parts.

Machine tools, portable tools, grinding and polishing equipment, die-sinkers, Do-All equipment, cut-off saws by DeSanno, these and many other mechanical exhibits were found in profusion. Lack of time and space make it impossible for us to do justice to any but the few companies and products mentioned above.

Truly it was an event that could be envisaged only by personal visit. And those who could attend found the spectacle well worth the time that had to be borrowed from war production activities.

Owing to the host of important technical papers on metallurgy and fabrication presented at the sessions of the cooperating groups, it has been desirable to deliberately select but a few examples for special comment in this report.

Let us consider, first, a group of ASM papers. Of prime interest were three papers on hardenability. Morse Hill, assistant metallurgist, Materiel Center, Army Air Forces, presented a study on "The End Quench Test: Reproducibility" in which the end-quench method is examined for sensitivity to variable conditions by the use of cooling rates and hardness determinations. The author presents cooling curves at various points, indicating that transformations are predictable from the S-curve. He concludes that the only test condition which must be under control is the prevention of scale on the quenched end of the specimen. Other test conditions may be permitted to vary within a fairly wide range.

The same author also presented a companion paper, "The End-Quench Test: Hardenability of Aircraft Steels," a study of variation in hardenability within single heats, single types, among the aircraft quality steels. According to Mr. Hill, variations are considerable, being greater in the lower alloy-content steels. The author has found that the hardenabil-

A WAYNE TUBE BEADER

BEADS TUBES MANY TIMES FASTER!

BEADING and flaring tubes is no longer a source of delay if you have a Wayne Tube Beader. It beads or flares aluminum or copper tubes many times faster than by usual hand methods. Releases skilled men for other work, as the most inexperienced man or woman can operate it. Does not mar tube surface or weaken metal structure. Saves more than its cost in a very short time. Now in use in leading aircraft plants. Write for more information.

THE WAYNE PUMP COMPANY
FORT WAYNE · INDIANA

NOW YOU MUST LEARN *"HOW-TO-DO-IT"*

BETTER..CHEAPER..WITHOUT WASTE

CAN YOU USE HELP?

We have available a new motion picture and a booklet (soon off the press), both on "*Stainless Steel Welding.*" Also for your production men, a complete "*Handbook of Special Steels.*" For your engineers, certified "*Blue Sheets*" on each tool and stainless grade. For your apprentice or training courses, "*Elementary Discussions on Tool and Stainless Steels.*"

● Write for the informational help you need. In addition, the personal assistance of our Technical Staff is at your call.

PRODUCING constantly improved war goods at a diminishing rate of cost, and an increasing rate of speed, ordinarily wouldn't be much of a trick for America. It's right up our industrial alley.

But conditions today are not as usual. There is no inexhaustible ocean of materials. There is, instead, a controlled stream flowing through rigidly restricted channels. We have to do *more*, actually, with *less.*

Thrift is especially essential with the vital steel alloys. If you use alloy steels in *any* form, check your dies, your cutting tools and machine set-ups, your heat-treat and welding methods—check and recheck every operation to reduce rejects, spoilage, undue scrap, or any other form of waste. Above all, carefully segregate and classify your unavoidable alloy steel scrap (*that is the only way the mills can reclaim it*) and rush it back into the useful cycle.

Allegheny Ludlum
STEEL CORPORATION
GENERAL OFFICES: PITTSBURGH, PENNSYLVANIA

A-8665 . . . W & D

ity curve can be represented by three straight lines which may be numerically presented with a gain in compactness where large numbers of specimens are to be compared.

"Hardenability Control of a One Per Cent Carbon Steel," by G. R. Barrow and Gilbert Soler, Steel and Tube Div., Timken Roller Bearing Co., describes a method in which the hardenability of this type of steel can be successfully estimated by totaling the percentages of manganese, silicon, chromium, and nickel. The method stems from data accumulated over a period of five years of research work in which a large number of heats of electric furnace steel were melted and each of the heats successfully allocated into one of five hardenability ranges. The paper describes the test procedure employed by the authors, intimates that other known methods have been explored without success.

Taber de Forest, Magnaflux Corp., in "Fluorescent Penetrant Method of Detecting Discontinuities," reported on the new Magnaflux test procedure which detects cracks and porosity in metals by means of a suitable penetrating fluid carrying a highly fluorescent dye. In operation, the method is similar to the oil and whiting technique so widely employed today.

Valuable contribution to the art of X-Ray examination of metals is a study entitled, "On the Location of Flaws by Stereo-Radiography," by James Rigbey, Ford Motor Co., of Canada. This is a new technique in which stereoscopic radiographs utilizing two exposures corresponding to two positions of the X-ray tube may be made on a single film. This enables direct measurement of the distance between the two images of the internal defect. From these data, the vertical position of the flaw can be estimated mathematically, thus eliminating the need for special viewing apparatus.

Prof. O. W. Boston and L. V. Colwell, University of Michigan, presented the results of a project initiated by the International Nickel Co., on "The Effect of Hardness on the Machinability of Six Alloy Steels," the correlation being effected by means of a series of turning tool-life tests. Tool materials, tool shape, size of cut, and cutting fluid represented commercial practice. Among the conclusions presented by the authors were the following:

1. In general, the S.A.E. X4345 steel, the S.A.E. 4145 steel, the S.A.E. 3145 steel, and the S.A.E. 4645 steel, in the quenched and tempered condition, have higher cutting speeds for a given tool life than the S.A.E. 5145 and G.M.C. X3045A steels. The specific machinability ratings vary somewhat for the heavy and light cuts, however.

2. The first group of tests involving heavy cuts with a cutting fluid indicates that, for general machining purposes, the S.A.E. X4345 steel has the highest cutting speed, such as V_{30}, of all the six steels tested. This is particularly true at hardnesses below 400 Brinell. The S.A.E. 4145 steel approaches the S.A.E. X4345 steel at high hardness, but it could not be machined with consistent results at hardnesses of 450 Brinell or higher. The S.A.E. X4345 steel displayed remarkable consistency, even at the very low turning speeds necessitated by the hardnesses above 400 Brinell.

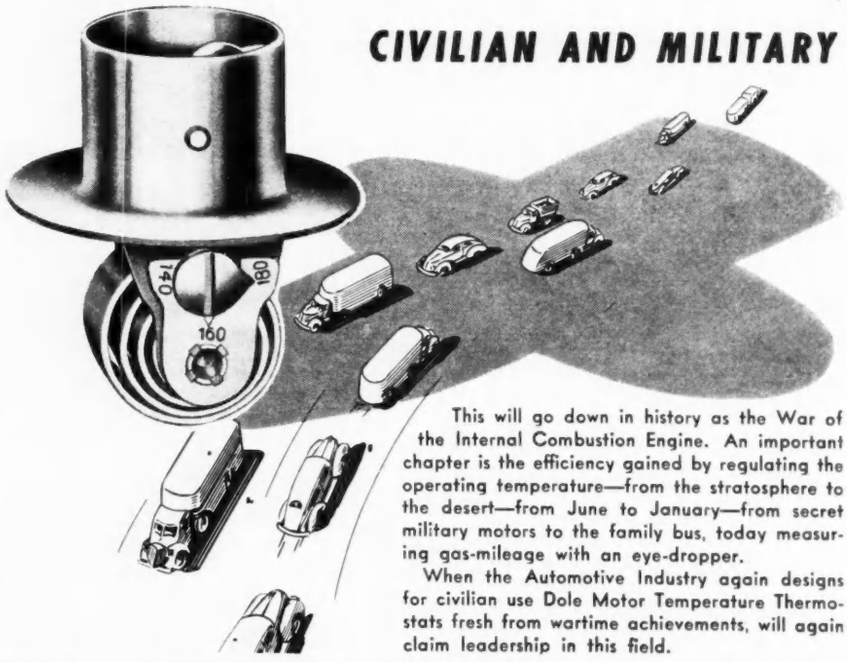
3. The second group of tests involving light cuts shows the S.A.E. 4645 steel to have the highest machinability rating, such as V_{10}, except for the difficulty likely to result from poor hardenability. These tests give a chip formation somewhat different from that of the first group as it is a proportionately thicker chip, similar to those obtained in threading operations.

4. One of the prerequisites for good machinability in the high hardness range, that is, greater than 400 Brinell, is that the steels possess a high degree of hardenability or uniform hardness penetration. This is evident from the fact that both groups of machinability tests show that the cutting speed for a given tool life may be reduced 15 per cent for approximately a 5 per cent increase in Brinell hardness. This being the case, a steel possessing good hardenability is necessary to avoid pronounced variation in hardness about the periphery, along the axis, and radi

MOTOR TEMPERATURE CONTROL FOR THE

ENGINES OF WAR

CIVILIAN AND MILITARY



This will go down in history as the War of the Internal Combustion Engine. An important chapter is the efficiency gained by regulating the operating temperature—from the stratosphere to the desert—from June to January—from secret military motors to the family bus, today measuring gas-mileage with an eye-dropper.

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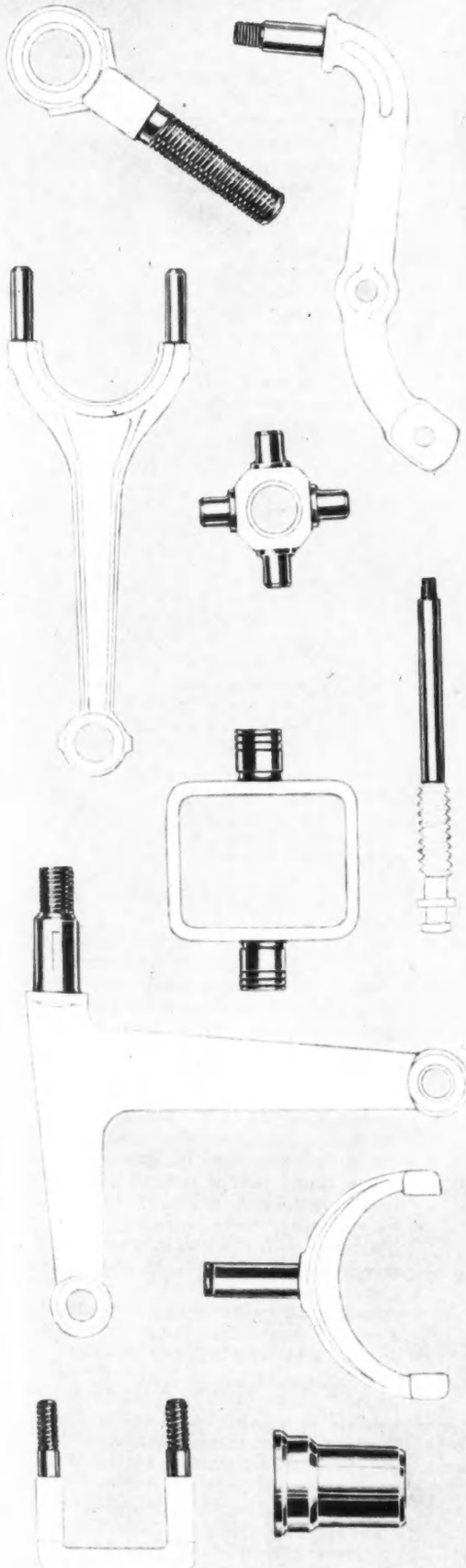

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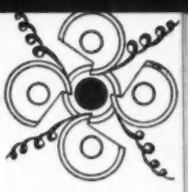
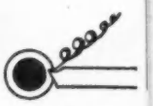


4 chips at each pass



1 chip at each pass

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On vital war parts like these, the 3 to 1 advantage of circular mills over single point tools shows a big saving in *cutting time alone*. But you save much more than that:

After grinding one or more single point tools, you must adjust each tool to cut its individual diameter, radius or shoulder. This takes time and often wastes product.

Compare with this — to sharpen a set of circular mills you check them to a predetermined micrometer gage reading, replace them in the head, and *one* simple *adjustment* brings all four to exact cutting size. No fussing for sizes, no experimental scrap loss.

These Self-Opening Hollow Mill heads also shorten the time cycle — snap open at end of cut, avoid "step" marks and insure uniform finish.

And don't forget this: Circular tools give you 10 times more cutter or chaser life, and you can hollow mill and thread with the same head simply by changing circular mills to circular chasers with chaser blocks — "Double Duty" tools.

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ally, arising from variable factors in heat treating practice. Considering the above qualifications, and reviewing the results obtained from this project, the S.A.E. X4345 and 4145 steels, which possess good hardenability, should also have superior machinability ratings in commercial practice when compared with the other four types of steels tested. This applies only to the quenched and tempered condition which usually involves hardnesses considerably higher than those of annealed steels.

Edward L. Bartholomew, MIT, in a study entitled, "Stress-strain Measurements in the Drawing of Cylindrical Cups" provides conclusions that have an important bearing upon the problems of deep drawing in the war program. The following will be of interest to those concerned with press shop operations:

1. A "critical section" exists in the drawn cup wall, at which location failure will occur for the given set of press conditions when the limit of drawability of the metal is reached.

2. The limit of drawability may be satisfactorily indicated by the maximum blank diameter which may be drawn without local necking or failure at the critical section.

3. The maximum blank diameter representing the limit of drawability for the metal may be accurately and consistently determined within 0.05 inch for any given set of conditions.

4. Definite correlation exists between the maximum stress in the critical section of the cup wall at maximum drawability and the actual stress from the tensile test at maximum load or limiting uniform deformation.

5. Reasonable agreement exists between breaking stresses at the critical section and actual breaking stresses from the tensile test.

6. The limiting uniform strain, q_u, shows a more definite relationship to maximum percentage reduction in cupping than does the common elongation value measured in 2 inches.

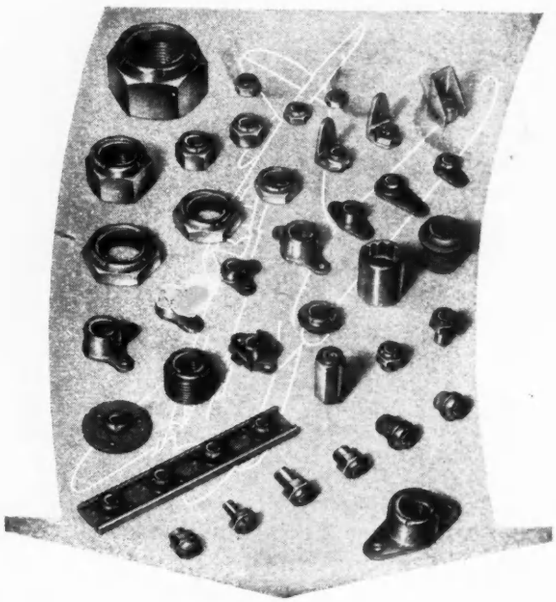
Coming to the proceedings of the American Welding Society, we find a paper by W. F. Hess, and C. R. Schroder, Great Lakes Steel Corp., on "The Spot Welding of N-A-X High-Tensile Steel." Two reports submitted to the welding research committee of the AWS indicate that remarkable improvement in the toughness of spot welds in hardenable steels is possible by brief heat treatment in the spot welding machine, following welding. Mechanism of toughening consists of allowing a drastic quench to martensite followed immediately by a high draw just below the critical. Heat treating current must be carefully adjusted to raise the temperature as high as possible without reaching the critical. A time interval of two cycles is sufficient to secure the maximum benefit of post heat treatment.

"Arc Welding of Magnesium Alloys" by W. S. Loose and A. R. Orban, Dow Chemical Co., describes the known methods and equipment in use today, also touches on the Heliarc technique which was described in AAI, Sept. 15, 1942.

A. R. Lytle and K. H. Koopman, Union Carbide and Carbon Research Laboratories, reported on the weldability of NE 8630 steel for aircraft structures, found that it was at least equal to that of SAE X4130 steel in the thickness tested. Some welding rods regularly used for aircraft work do not meet the requirements of sound weld design. Application of a suggested specification covering minimum tensile strength and bend elongation should provide a satisfactory procedure.

"Welding of Aircraft Propeller Blades" is described by C. A. Lindholm, Curtiss Propeller Div., Curtiss-Wright Corp., in which three different methods are currently employed—Atomic hydrogen welding arc for the edges, Unionmelt welding for the outside shank seam and cuff retaining ring, and oxy-acetylene gas welding for the inside seam. The production process is critical to control, relies upon the application of the following principles—

adaptation of unique design to the physical properties of the weld
careful selection of raw materials,
advanced manufacturing methods,
rigid production and inspection control.



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Their locking action is immediate and automatic . . . no pins, no washers, nothing to forget.

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Threads of nut and bolt are held in contact under constant cushioned pressure. The nuts stay put.

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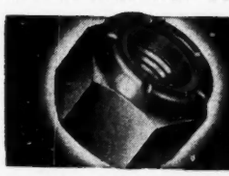

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Other vitally important papers on welding included the following—"Welding—its Application to Aircraft" by Francis H. Stevenson, Vega Aircraft Corp., dealing with fusion and resistance welding of various fitments, cluster welds, welding of mounts, fabrication of exhaust collector rings, etc.; "Factors Affecting the Accuracy of Ordnance Machine Cutting" by Howard G. Hughey and August H. Yoch, Air Reduction Sales Co.; "Distortion and Shrinkage Problems in Ships and Other Large Structures" by LaMotte Grover, Air Reduction Sales Co.

One of the highlights of the Wire Association meeting was the paper, "Cemented Carbide Manufacture and Applications" by A. MacKenzie, vice-president in charge manufacturing, Carboloy Company, Inc. The author dealt specifically with the use of Carboloy for drawing operations on automatic and semi-automatic machines, in wire drawing, tube, and bar drawing applications. Recent development is the extrusion of rods, tubes, and non-symmetrical cross-sections such as angles, flats, half-rounds, ovals, etc., in lengths not hitherto available. Carboloy dies are being used today for drawing steel wire down to 0.010 in.

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Ternstedt Now Making Aircraft Instruments

(*Continued from page* 33)

Numerous watchmakers and many women are employed on the instrument job. Tests and checks through which the instruments must be put are almost innumerable. They must be checked to a perfect balance after every single operation. The rotor, which turns at 12,000 rpm, is the key factor in the gyroscopic operation. Its shafts are machined and polished to a tolerance of .0001 in. All bearing surfaces must be made as hard and accurate as possible.

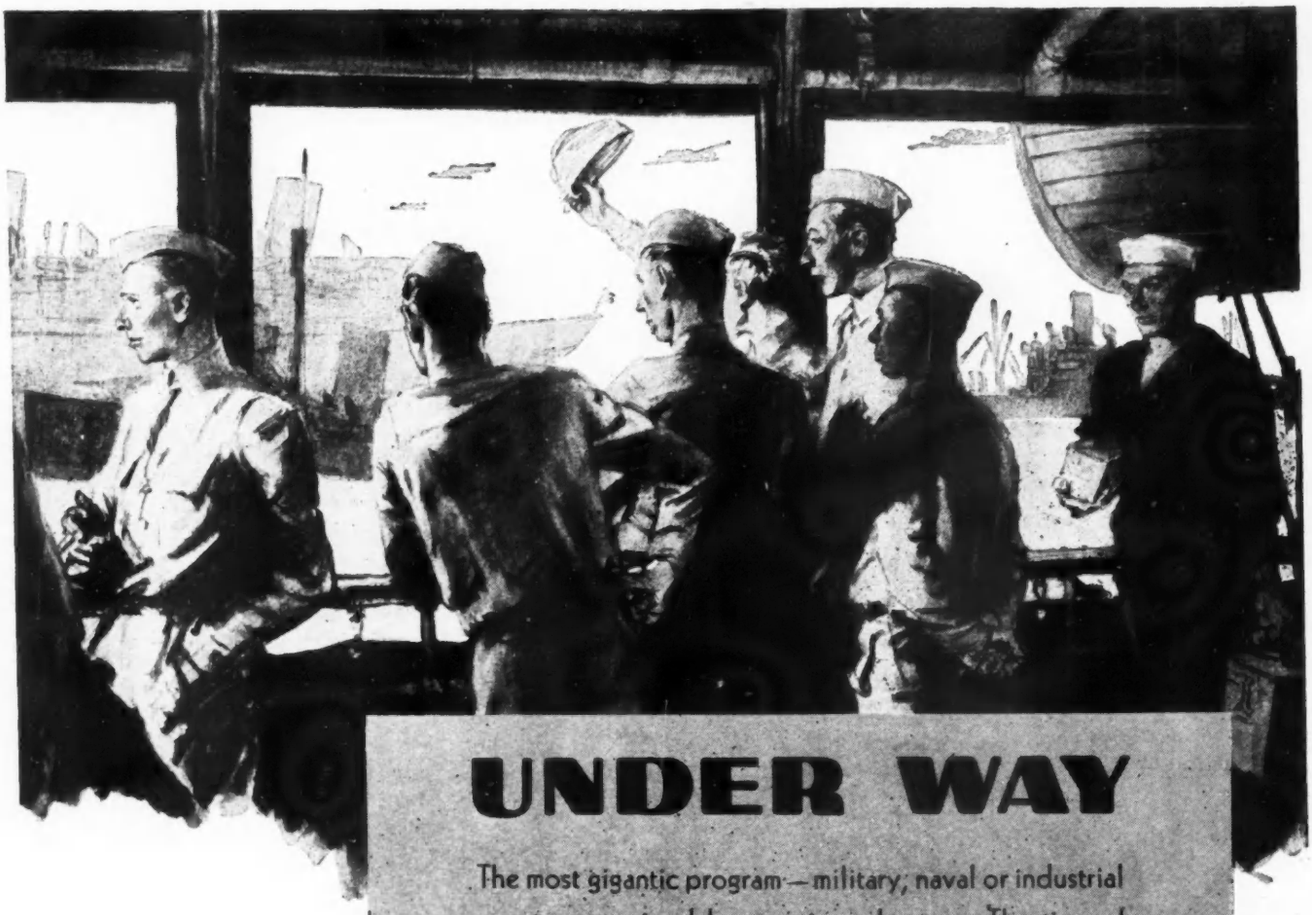
For one test, the instruments are inserted in an ice box which registers 31 deg. below zero, then taken from there and placed in 128-deg. heat. Unless every bearing is truly set a contraction in the cold or expansion in the heat will throw the instrument out of order. As another test they are placed on a machine which puts them through an incessant roll, pitch and yaw, simulating the motion of a plane in flight. For delivery, every instrument is locked and specially sealed ready for immediate use on a plane.

Electrodeposition of Hard Nickel

Problems connected with the surfacing of parts to resist wear and corrosion, the forming of unusual metal shapes, and the salvaging of worn and mismachined parts were discussed by Drs. W. A. Wesley and E. J. Roehl in a paper entitled "The Electrodeposition of Hard Nickel" before the Semi-annual meeting of the Electrochemical Society. The authors said that nickel deposits of 380 to 480 Vickers hardness can be produced in thickness and quality suited to industrial and engineering applications by use of electrolytes containing ammonium salts. They showed experimentally that the soundness and structure of such deposits are markedly influenced by the composition of the plating bath in respect to other ingredients.

Important improvement in the quality of the product can be accomplished, they contended, by replacing the old hard baths with one composed of nickel sulfate, ammonium chloride and boric acid. This electrolyte is well buffered and contains sufficient chloride to insure high anode efficiency. The hardness of deposits made from it varies but little with change in thickness and can be easily maintained by control of the plating conditions.

Drs. Wesley and Roehl are connected with the Development and Research Division of The International Nickel Company, Inc., Dr. Wesley being assistant director of the Company's Bayonne, N. J., research laboratory.



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The most gigantic program—military, naval or industrial—ever conceived by man is under way. The time of building factories, tooling up machines, laying out production lines is now past. The job itself is under way.

The U.S.A. is in high gear. Ships are slipping down the ways, tanks are rolling off the lines, planes are taking off from factory run-ways. American troops on the far-flung battle fronts of Democracy are getting what they need in reinforcements and armaments. The fight is getting started in earnest. It will end when Uncle Sam says it is over. Here at General Machinery the management and the men feel the rhythm and magic of well organized production. There's a stimulating swing to it that the men of industry can sense as they go about their daily tasks. We know it's here—we see it—we hear it—we feel it. America is under way.

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GENERAL MACHINERY ORDNANCE CORPORATION

The Unionmelt Welding Process

(*Continued from page 37*)

reel. The distance between the end of the rod and the base metal is maintained constant by a special automatic control which translates any slight variation in voltage across the welding zone into compensatory variations in the operation of the rod-feed motor.

"Unionmelt" welding heads are available in three sizes—large, intermediate and small.

The large-size head is known as Type M and weighs about 435 lb. It will feed coiled or straight rod in any size up to ½ in. in diameter, will handle current up to 4000 amp, and will weld steel 2½ in. thick in one pass.

The intermediate-size head is known as Type U and before shortages of aluminum forced the substitution of heavier material for some of the parts weighed about 125 lb. It will feed coiled or straight rod in any size up to 5/16 in. in diameter. it is designed for currents up to 2000 amp, but will handle somewhat higher currents and with it steel 1¼ in. thick can be welded in one pass.

The small-size head is known as Type S and weighs only about 15 lb. It will feed only straight lengths of welding rod up to ¼ in. in diameter, which is used either in 16-ft lengths as supplied, or in shorter lengths cut on the job. It is designed to handle currents up to 1000 amp but is frequently used for 1200 to 13,000 amp and with it steel up to ½ in. in thickness can be welded in one pass.

The examples of maximum thicknesses that each size head is capable of welding in one pass do not indicate the thickest material for which the head is useful. With double-vee joints, approximately twice the thickness mentioned can be welded by making a single pass from each side. Multi-pass welding can be used for greater thicknesses.

The welding heads can be mounted either on a stationary support under which the work is moved, or on a supporting structure which travels over the work to be welded; or, in some instances a special rod holder can be moved by hand. The Types U and S heads are frequently mounted on a portable electric motor-driven carriage which rides directly on the workpiece or on portable sections of track. For shops using this process in the repetitive fabrication of pressure vessels, tanks, pipes, and similar work of relatively large size, the welding head is often mounted on a light wall crane or gantry crane, or it may be mounted on the end of a cantilever for insertion into the shell to make both longitudinal and circumferential welds from the inside as the ends and various courses are assembled. In welding machinery parts and relatively small structural units held in jigs, the welding head is usually so mounted that it can travel over two or more jigs arranged in such a way that positioning of the work, welding, and removal of welded assemblies can be carried out most efficiently.

Electrical Equipment

The "Unionmelt" welding process uses either alternating or direct current at from 20 to 55 volts across the welding zone. Currents are much higher than those used with metallic arc welding, ranging up to 4000 amp. Current densities four to five times as high as those usually used in metallic arc welding, partly account for the greater welding speeds of "Unionmelt" welding. Heavy-duty welding transformers with built-in, motor-controlled reactors are standard products of several manufacturers of electrical equipment and are the most generally used source of welding current.

All electrical controls are usually located near the welding head and in a position convenient to the operator of the equipment. These include controls for amperage and welding voltage for regulating the rod feed and for moving the head in relation to the workpiece.

The Operator

The operator of "Unionmelt" welding equipment is not required to have the highly developed skill required for manual welding. He needs only to be able

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We're correlating time, men, machines and materials to give you what you want when you want it. You'll like this kind of service — it saves time, money and headaches. Let's talk it over.
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J
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No sparks to cause fire, no radio interference, fewer parts.
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First A.T.C. certificate for airplane use granted more than 10 years ago.
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to follow directions giving him the proper voltage amperage, and speed requirements. Once the welding machine is set to operate, on a uniformly and properly prepared joint, his duties consist largely of pushing control buttons and observing conditions. Since no sparks, flash, or smoke are given off, it is not necessary that he wear shields, goggles, helmets, or protective breathing apparatus. He is not subject to the usual fatigue associated with manual welding and no continuous exercise of care and skill is necessary to assure high quality in every part of every weld. Thus, by reducing the importance of "the human element," maintaining uniform quality is greatly simplified.

Delco-Remy Aluminum Foundry

(*Continued from page* 23)

there is a small department just to one side of the main molding conveyor, self-contained in every respect for the production of small castings, employing hand molding methods. In another section of the foundry, there is a self-contained molding line quite similar to the main line mentioned earlier, although it is somewhat smaller. In addition there is the permanent molding department which constitutes a separate, self-contained foundry.

Since the operation of the modern aluminum foundry depends so much upon scientific control and research, it is of interest to touch upon some of the activities of the metallurgical department. The laboratory has been designed to provide a complete set-up for the control of the product. Although numerous research problems are being investigated, the bulk of the work is strictly production foundry control along the following lines:

a. Chemical and spectrographic analysis
b. Physical testing
c. Metallographic and X-ray analysis

The chemical laboratory is laid out for the analyzing of from 15 to 20 samples of alloy per shift. The spectrographic laboratory allows ample working space for approximately two men per shift. The physical testing laboratory handles the following activities:

1. Test bar checking for tensile strength, hardness, etc.
2. Sand testing control and research
3. Experimental heat treating
4. Breakdown test for castings
5. Fatigue testing

Since every crucible of metal carries a set of test bars, the physical testing laboratory pulls hundreds of test bars per two shifts. Molding sand is checked for moisture, permeability and green compression strength every half hour. Experimental work on heat treating, fatigue testing transverse strength of castings, and research on both molding and core sand also are part of this laboratory's program.

The metallographic and X-ray department has complete equipment for both micro and macro examination of castings and is used largely to determine quality of heat treatment, pouring temperature, nature of porosity, and allied problems. Probably the most important single tool is the X-ray. This instrument ties in closely with production problems and is used extensively in analyzing the gating for new castings. It is also used to determine types of defects and this is, of course, of considerable importance in correcting such defects.

The foregoing touches briefly on the control and operation of this modern aluminum foundry. To the outsider there is nothing dramatic in its operation so far as visual evidence is concerned, since the process is smooth, clean, free from physical effort on the part of the workers. To the seasoned foundryman, these very facts prove its efficiency and modernity, give ample evidence of excellent planning and outstanding equipment and materials handling facilities which are so intimately associated with mass production techniques. The pictorial section will provide the reader with a better visualization of some of the activity outlined in the text.

Buyers of equipment and machined steel products are pushing their suppliers for delivery. Therefore, any item that will help you speed production will speed delivery.

Eliminating any operation on boring, turning, or facing steels decreases the time necessary to get needed equipment to your customers, and increases your plant's production ability.

KENNAMETAL often eliminates a finish cut when machining steel by giving a smooth, accurate finish on the initial cut. Furthermore, KENNAMETAL'S great strength and hardness permit it to take heavy feeds at high cutting speeds, and in addition to faster production on boring, turning, or facing operations KENNAMETAL will take jump cuts or machine steels up to 550 Brinell at economical feeds and speeds.

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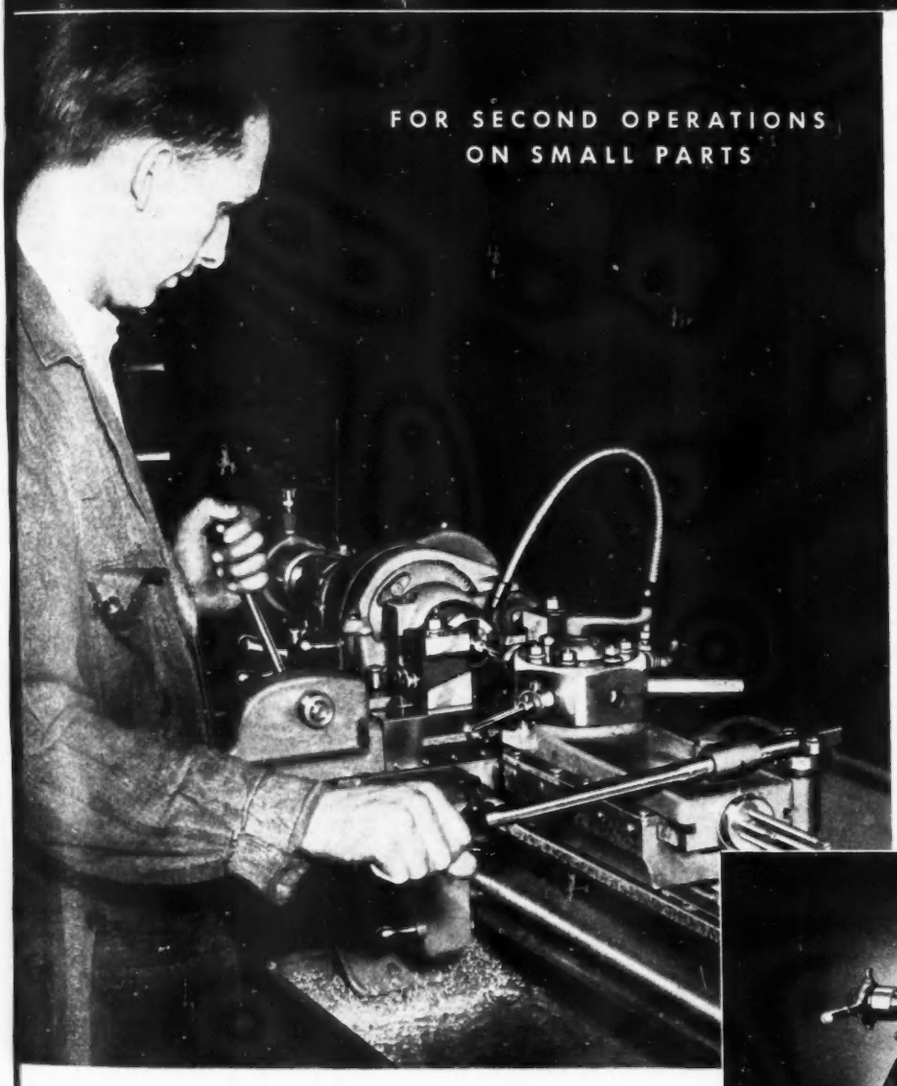
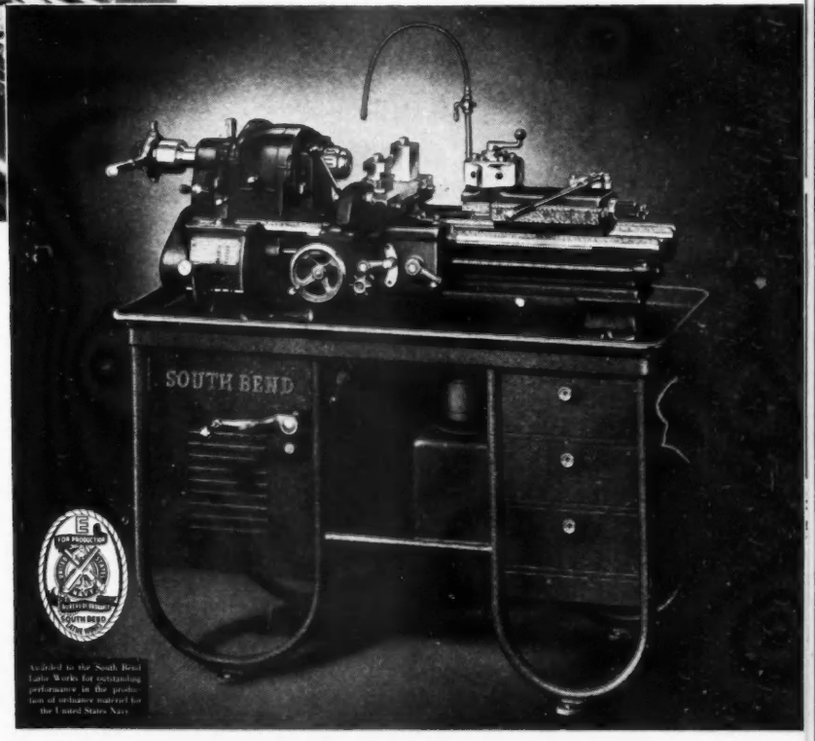
New SOUTH BEND TURRET LATHES



Designed for the rapid machining of small duplicate parts, the new Series 1000 South Bend Turret Lathes are especially adaptable to second operation work. Their speed, accuracy and versatility make possible rapid production without sacrificing efficiency or precision.

Features that contribute to the versatility and efficiency of these lathes are the smoothly operating handlever bed turret, the handlever cross slide with double tool blocks, the compound cross slide with power longitudinal feeds and power cross feeds for the universal carriage, forty-eight precision thread cutting feeds driven by a lead screw, and a wide range of spindle speeds.

The handlever bed turret indexes automatically on the return stroke and is equipped with an adjustable feed stop for each face. The handlever cross slide has adjustable stops for both the front and back tool blocks. Standard extras simplify tooling this lathe for war production and make it easily convertible to other work when peace comes.



Series 1000 Turret Lathes

The Series 1000 Turret Lathes have a 1⅜″ spindle hole, 10⅛″ swing over bed, and 1″ maximum collet capacity. They are made in bench and floor types—with or without coolant equipment. Standard equipment includes quick change gear box, power feed universal carriage, handlever cross slide, compound rest cross slide, and handlever bed turret. Standard extras (not included in prices of lathes) include 4-way turret tool block, tailstock, collet attachment, taper attachment, thread dial indicator, and micrometer carriage stop. Write for Bulletins 1002 and 1004 which contain complete information and specifications.

SOUTH BEND LATHE WORKS

DEPT. 765 SOUTH BEND, INDIANA

Lathe Builders for 35 Years

Removal of Broken Drills

(*Continued from page* 31)

assorted welding rods, were purchased. The usual type welding rods which were supplied with the outfit were not the most suitable for the special job of removing broken drills and reamers. The tests clearly showed that the bond between the broken part and the welding rod was strongest when the welding rod consisted of stainless steel. As a result fluxed stainless steel welding rods were substituted for the ordinary type. The hard flux on the outside of the stainless steel welding rods also serves effectively as an insulator especially when inserting a rod in a drilled hole where the broken drill is several inches below the opening of the hole.

In addition, a non-fuming compound for protective purposes on finished surfaces, known as Spatter-off, was obtained. Having the consistency of medium lubricating grease, this can be spread easily in a light layer over any finished surface where protection from arc flashing is desired. When an arc flash occurs near the Spatter-off, the heat of the arc immediately causes it to harden into a non-combustible layer of protective crust. After the welding operation is completed and the broken part is extracted, this protective coating can be quickly removed, and by degreasing the part, the original bright quality of the finished surface is restored. In specific cases, other forms of protection from the arc flash are used. For example, wet asbestos powder, fiber washers or bushings, ¼ in. brass plate drilled to fit over the opening of the drilled hole (especially when the broken drill is at the surface of the hole) and other materials depending upon the requirements of the job to be done.

Technique

Fig. 1 shows the operator preparing an engine part for the extraction of broken drill. By using a high pressure air hose, the hole containing the broken drill is blown clear of all extraneous matter such as metal chips, oil, dirt, and bits of shattered drill. A small prod carefully used often helps considerably in removing metal chips jammed into the area between the cutting edges of the broken drill where the butt-weld is to be made. Particularly if the chips are aluminum or magnesium, it is always good practice to minimize the possibility of blow-back and unnecessary oxides in the vicinity of the welding surface due to the ignition of the chips at the moment the arc contact is made. Carbon tetrachloride also should be used to wash out any cutting oil or coolant films remaining in the vicinity of the broken tool. This is a very important feature of the cleaning process.

With the welding rod already in the welding fixture, Spatter-off is applied to protect the finished surfaces of the part. In preparing the coated welding rod prior to its insertion into the welding fixture, it is good practice to round off the end of the rod on a grinding wheel to insure a good welding contact. Also, a "dog" should be tightened on to the rod near the end which is to be inserted into the welding fixture. The "dog" provides a place to apply impact with a hammer after the weld is made in order to provide an extracting force to the broken part.

The welding fixture serves a dual purpose. First, it guides the welding rod into the drilled hole in proper alignment with the center line of the broken drill. Secondly, after the weld is made it serves to hold the rod steady when applying the extracting impact with hammer blows. It is particularly useful when extracting small broken parts where the diameter of the drilled hole is in the vicinity of .040 in. to ⅛ in. The welding fixture is supported by a modified heavy duty lighting fixture, having its tubing replaced by solid shafting for greater rigidity. An arrangement of this sort is inexpensive and serves a satisfactory purpose when properly anchored to the bench.

In Fig. 2 the weld has been made and the operator is about to apply to the "dog" the extracting impacts with

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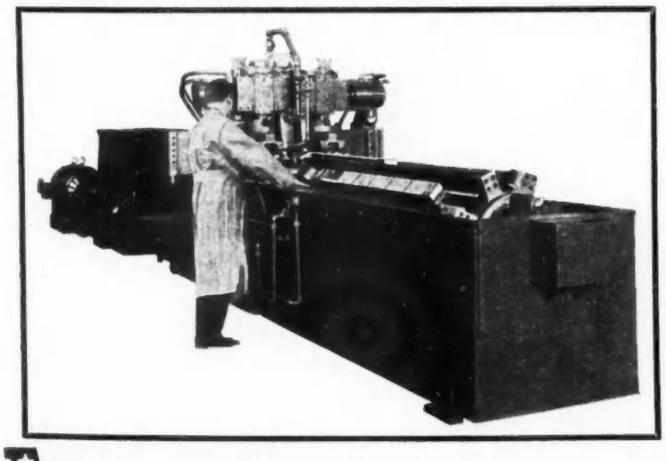
6 BROACHING OPERATIONS *with* 1 MACHINE SET-UP...

...ON 75MM CANNON BREECH BLOCK



. . . "Somewhere in the Middle West," a mammoth gun plant is producing breech blocks for 75 MM Cannon with the aid of the special AMERICAN broaching machine shown to the left. This machine was furnished complete with hydraulic fixtures and tooling for the operation. The revolving broach handling cradle can be seen to the front of the machine. This machine facilitates broaching one of the large breech blocks while another is being loaded on the opposite side of the special fixture. Compared to machining these blocks by conventional methods, production obtained is very high.

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a hammer. Note that the words "extracting impacts" are used rather than "extracting force." Broken drills when jammed tightly with chips, respond to hammer impacts better than they do to steady pulling with a tensile machine or other means.

Quality of Butt-Weld

The test of the quality of the butt-weld comes at this time as shown in Fig. 2. Sometimes crystallization occurs in the weld or blow holes form due to the presence of cutting oil and various oxides, thus causing the weld to break under hammer impact. In such cases it is usually necessary to reinspect the point of contact of the stainless steel welding rod, clean the chip oxides from the drilled hole, or readjust the ampere rating of the power supplied to the weld to better suit the size and material of the broken drill. Frequently, however, it is discovered that the broken drill was shattered when it broke in the drilled hole. This necessitates several welding attempts before the solid part of the drill is reached. Experience shows that occasionally as many as five to ten tries have to be made before a solid part of a drill can be removed. Also this frequently happens when unauthorized attempts are made to remove the drill by pounding the part, or by trying to drive it out with a prick punch.

At this point it is advisable to stress the importance of having machine operators or set-up men make absolutely no attempts to remove any broken tool from engine parts. Frequently, a feeling of embarrassment on the part of the operator in having to report a broken drill or reamer to his foreman is the incentive which causes the operator to seek means of removing the broken tool himself. The usual crude method employed by an operator is trying to drive it out, or break it out piece by piece, with a prick punch and hammer. Experience shows that this method is seldom successful and usually results in burred surfaces and other forms of distortion which directly cause scrap or which tend to defeat the purpose of the arc welding method of removal. Also the use of a prick punch and hammer frequently results in broken punch points being tightly lodged in the hole above the broken drill.

Fig. 3 illustrates the setup for extracting a broken pilot from the drilled hole in a cylinder pad. The same removal technique was used to extract this pilot as was used in removing the broken drill from the engine part shown in Fig. 1 and 2. Note that Spatter-off again protected the finished surfaces in and around the drilled hole.

In Fig. 4 the entire layout of apparatus for this job is shown. Note that the flex arc welder at the right has plug-in positions to make available various ampere ratings from 20 to 250 amperes to suit the requirements of any job using welding rod from 3/32 in. to ¼ in. in diameter. So far in the development of this welding method 3/16-in. diameter stainless steel welding rod has been sufficient in tensile strength to do the toughest job at Pratt & Whitney Aircraft, which was the extraction of a 4 in. long ⅞ in. reamer having eight flutes.

The smallest size drill removed by this method was a .040-in. drill in the bottom of a 5/16-in. hole 3 in. deep in an engine crankcase section. A previous method of removal would have been to trepan around the broken drill and insert a plug of the same material. This would then have necessitated the reoperation of the .040-in. oil hole in the production line. The time required for trepanning, plugging, re-locating in the fixture and re-operating would have required several hours of labor. But by the new welding method actually used, a 3/32-in. welding rod was ground down to a sharp point at the contact end and covered with an insulating coat of glycerothalate in the ground-down area. The current rating of the flexarc was reduced to 30 amperes, the welding rod was inserted in the 3-in. deep hole, and centered on the .040-in. drill. Contact was made with the broken part of the drill and the power to the transformer turned on. The result was a butt-weld of sufficient strength to permit the extracting of the broken drill. As no damage was done to the .040-in. oil hole, the crankcase section immediately went back into production.

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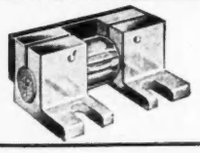
(7) 	(7) Heavy Duty Hi-Amp. Anti-Vibration Littelfuse. Rating 40 to 150 amps. 1¾" standard length. 1½" for ratings to 100 amps. Transparent body for easy inspection.
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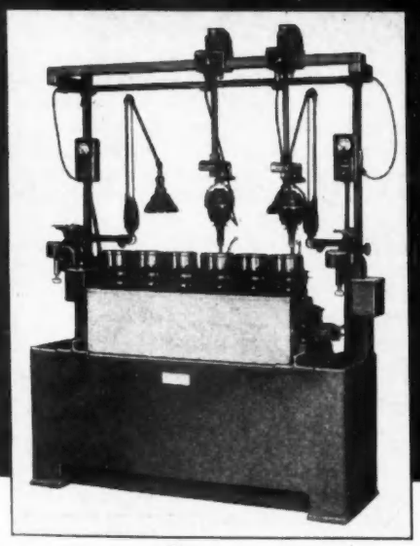

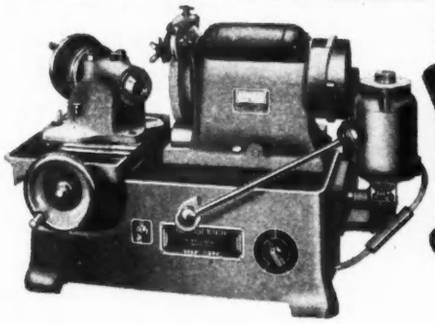

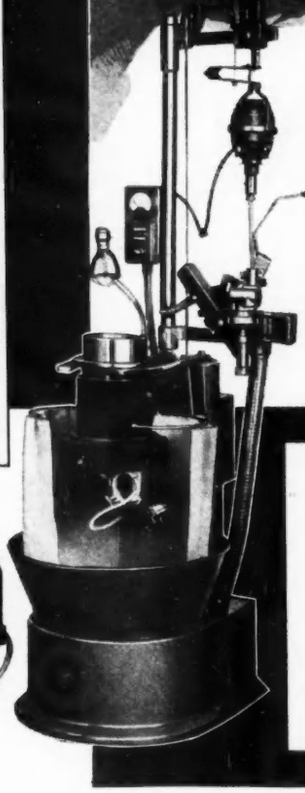

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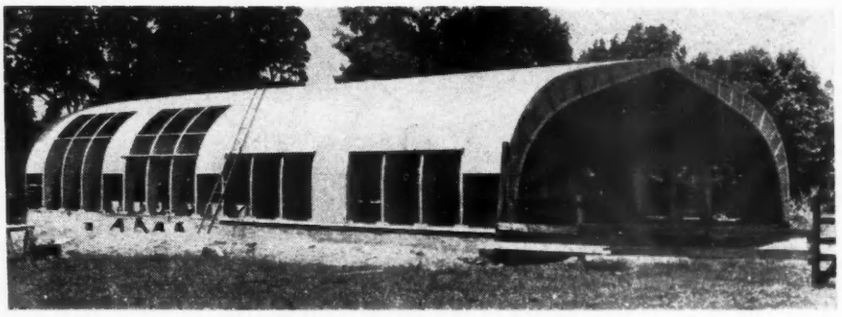
From *The Horseless Age*, Oct. 15, 1902.



Plywood Houses for Aircraft?

Pre-fabricated almost entirely of plywood and laminated wood strips, bonded together with Plaskon resin glue, the first model of a new aircraft hangar has just been assembled by the Marine Air Research Corp. of Annapolis, Md.

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WPB Production Award To GE Veteran

Approximately 22 tons of steel—enough metal to make 44,000 bayonets—will be saved at a New Jersey plant of the General Electric Company this year, thanks to the patriotic ingenuity of a Swedish-born war worker.

The worker, Axel Johnson, suggested an improvement in the production of electric equipment for cargo ships which saves not only steel tonnage but 10 per cent of the operator's time.

The suggestion brought Johnson the first award of individual production merit granted an employee of the company by the War Production Board. He also received a check of $250 from the company.

A production veteran whose experience in the same plant dates back to World War I, Johnson suggested a pattern change which reduces the weight of brake wheels and enables a greater number of them to be obtained from the same amount of molten metal. Several pounds of steel are saved in each casting. Man-hours are saved because the lesser weight requires less machining of each brake wheel. The brake wheels are used in conjunction with motors which drive winches and other auxiliary equipment aboard cargo ships.

New Turco Paint Stripper

For quick and thorough removal of enamel, varnish, lacquer, zinc chromate primers and other paints, Turco Products, Inc. of Los Angeles, Cal., has just introduced Turco Stripper L-595. It is a solvent with what is described as a swelling action on paints and synthetic resins. It is said to be non-inflammable, wax-free and to require no after cleaning. It is also said to be non-injurious to most fabrics, to aluminum, magnesium, or other reactive metals.

Nine Months Ahead

The new Indiana division of Republic Aircraft Corp. has gone into production within five months and delivered its first P-47 Thunderbolt fighter plane nine months ahead of schedule.